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Forest Farming Practices

Forest farming in North America is becoming popular as a way for landowners to diversify income opportunities, improve management of forest resources, and increase biological diversity. People have been informally “farming the forests” for generations. However, in recent years, attention has been directed at formalizing forest farming and improving it through research and development activities. The purpose of this chapter is to present historical and modern perspectives, as well as examples of contemporary practices, to provide the reader an overview of the abundant opportunities in forest farming. Most of the discussion focuses on the southern United States and western Canada (i.e., British Columbia). These are illustrative of the many opportunities that exist, but do not cover other regions of North America (northeastern and southwestern United States, eastern Canada, or Mexico), where there are also examples of dynamic and exciting forest farming. The reader is encouraged to look beyond the examples provided and explore the many forest farming options.

People have been informally farming the forests for generations. Ever since they recognized the many benefits that can be realized from the forests, people have used these resources to meet personal needs and for profit. Indigenous people around the world have foraged from the forests for products to eat, to shelter them from the elements, to cover their bodies, and to aid them in medicating injury and illness. Today, indigenous people continue to farm the forests for much needed products. Moreover, landowners in general are becoming more interested in farming their forests to generate additional income.

In the last 25 to 30 yr, forest farming has been promoted as an alternative practice that can lead to better and more sustainable management of resources. The practices have been documented and formalized, but in many situations the science is not as developed as in other agroforestry practices. Much of the early promotion of this alternative land use system focused on developing countries, where people are more directly dependent on forest resources for basic sustenance. Promotion of forest farming in North America is relatively new and still evolving. The potential to diversify and stabilize income sources, increase forest health, and promote alternative “green” enterprises is tremendous. A student of forest farming in North America needs exposure to its historical evolution, the nuances of terminology, the enigmatic markets, and the diversity of possible products and production systems. This chapter was designed to provide students with a comprehensive

understanding of the great variety of opportunities and challenges with forest farming in North America.

Historical Perspective

Gathering forest products and nurturing forest resources, the general practices of forest farming, have origins far back in history. Long before the technology existed to cut timber, people were gathering forest products for personal consumption. Wanting to ensure the future availability of these products, people would nurture their patches by planting seeds, pulling weeds, and protecting their crops from poachers and herbivores. Early settlers to North America understood the importance of conserving these resources and took actions to help sustain them. Ginseng (*Panax quinquefolius* L.) hunters, for example, would purportedly collect and plant seed from the plants before harvesting the roots. Today, people are more formally farming the forests for a variety of products.

Examples of forest farming can be found from other continents as well. Developing countries probably have more experience with forest farming than we do in North America. Asia provides the largest collection of historical information regarding forest farming. In western Asia, tree crops have been regarded of vital importance for generations. The carob tree (*Ceratonia siliqua* L.) has been cultivated on marginal sites in Cyprus and Syria for many years. In Southeast Asia and the Pacific Islands, trees of the genus *Pithecelobium* have been farmed in forests for production of feed stock as well as a staple human food. White mulberry (*Morus alba* L.) trees are farmed in Afghanistan to provide a flour substitute for traditional breads. In Bangladesh, the traditional homestead agroforestry systems are a diverse array of trees and understory plants grown in small holdings to provide for household consumption and sale.

In Africa, the main target beneficiaries have been small-scale farmers since the promotion of forest farming began in the early 1970s (Kaudia and Omoro, 2001). This audience was viewed as having limited ability to switch to substitutes for forest products and could realize the greatest benefits from improved forest farming. Research and development of agroforestry in Africa was accelerated by the creation in 1978 of the International Centre for Agroforestry Research (ICRAF), known now as the World Agroforestry Centre. The Centre and its many partners in research and development have programs in four regions of Africa, as well as in Latin America and South and Southeast Asia. The World Agroforestry Centre

and other agroforestry programs in Africa are more oriented toward the introduction of tree species into agricultural systems than to forest farming, but in this and other regions work on non-timber forest products, including management of native species within existing forests (CIFOR, 2007), converges with agroforestry, reflecting integration of markets and livelihood strategies.

A North American Context

North America has a long history of farming the forest for native plants. In the southwestern region of the United States, the pods of mesquite (*Prosopis* spp.) were farmed from the forest to provide a staple used for flour. Farmers in the southern United States planted honey locust (*Gleditsia triacanthos* L.) in their crop fields to supply forage for winter feed. Mulberry for pig feed has been recognized in the South as a livestock feed source. A common historical view was that one good-fruited mulberry tree could supply enough food for one pig for 2 mo. Early work at the Agricultural and Mechanical College in Mississippi (Sholto and Hart, 1985) indicated that a single mulberry tree could produce enough food for two large hogs.

Aboriginal people have a long history of sustainable management of their lands and the timber and non-timber resources, including propagation, pruning, tending, weeding, selective harvest, and habitat modification (e.g., burning) (Turner, 2001; Turner and Cocksedge, 2001). Numerous examples of usage and management of non-timber resources by aboriginal peoples can be found throughout the forested regions. The sugar maple (*Acer saccharum* Marshall subsp. *saccharum*) syrup industry is perhaps one of the most well known examples of forest farming, with origins before European settlement. More recently, cottage industries for birch (*Betula* spp.), bigleaf maple (*Acer macrophyllum* Pursh.), and Manitoba maple (*Acer negundo* L.) tapping have taken root and are gaining in popularity. Products range from traditional syrups to wine and other value-added culinary products. The integration and management of crops in forested landscapes, as illustrated by the ways of aboriginal people, is an important complement to the integration of trees into agricultural landscapes.

During the late 1800s, settlers arriving on the windswept Canadian prairies transplanted seedlings from riverbanks and imported trees and shrubs from eastern Canada and the United States. Many of these plantings, however, were

unsuccessful, reflecting a lack of hardiness of the stock and poor site preparation. The Experimental Farm Stations Act of 1886 provided opportunities for coordinated and regionally based horticulture and tree production. In addition to grain and livestock trials, the experimental farms tested a wide variety of tree and plant materials for adaptation to regional conditions and plant production culture, disseminating results to the farm community (Dick, 1996). Early envisioned usage of trees in prairie landscapes included shelterbelts and windbreaks for protection from wind and snow, creation of microclimates supporting garden establishment and fruit tree culture, and establishment of farm plantations for wood and fuel. The planting of trees and shrubs into sparsely treed regions also served the aesthetic and psychological purposes of approximating pastoral landscapes in a period dominated by European or Euro-North American settlement (Dick, 1996). Tree planting was begun at several experimental farms, and tree seed and seedlings were distributed directly to settlers (Howe, 1986). In 1901, a permanent Forest Nursery Station (precursor to the present-day PFRA Shelterbelt Center) was established at Indian Head, Saskatchewan by the federal government to propagate and provide hardy tree and shrub materials to prairie farmers. The Prairie Farm Rehabilitation Administration (PFRA) was established in 1935 in response to the drought, soil degradation, and farm abandonment occurring. Its role was to "...secure the rehabilitation of the drought and soil drifting areas in the Provinces of Manitoba, Saskatchewan and Alberta, and to develop and promote within those areas, systems of farm practice, tree culture, water supply, land utilization and land settlement that will afford greater economic security..." (AAFC, 2007).

In 1929, J. Russell Smith described how "certain crop-yielding trees could provide useful substitutes for cereals in animal feeds as well as conserve the environment" in the rural United States. Early forest farming focused on harvesting products from trees to supplement farm production. Today, forest farming has progressed well beyond this rudimentary model. It has expanded to use the space under the trees to produce crops and other products. Trees have advanced from producers of products, to producers of services (e.g., shade and protection) to enhance production of understory crops.

Smith (1929) proposed "progressive establishment of massive complexes of tree farms." He envisioned "hills green with crop-yielding trees" in place of poor pastures, eroding gullies, and

abandoned farm lots. His ideal farm consisted of level and gentle sloped lands that were protected by terraces. Other areas were planted with trees, under which was planted high quality forage grasses. Smith advocated "two-storied" agriculture that allowed farmers to grow trees, while raising livestock under their shade. Now, almost eighty years after these visionary words were posed, silvopasture is well accepted in many parts of North America.

In the United States and Canada, focus has shifted to include a broader range of potential crops. An increasing number of references can be found from across Canada concerning non-timber forest products, predominantly based on wild-harvest information (e.g., Duchesne and Zasada, 2000; Wills and Lipsey, 1999; Tedder et al., 2000; Mitchell, 2004; Wetzel et al., 2006). Indeed, some recently arising terminology surrounding compatible management (Hobby et al., 2006) reflects a continuum of activities and intensities, from wild-harvest to extensive, intensive forest farming approaches. For example, research in British Columbia has revealed a range of approaches to "compatible management" (Haynes et al., 2003) of timber and non-timber forest products, although there is little inclusion of non-timber forest products considerations into overall forest resource management in the province. Compatible management activities can be understood as a continuum from "inactive" (or "passive") compatibility, such as using existing roads or topographic maps to identify or access non-timber forest products resources, to very active management, such as planting non-timber forest products species in forest ecosystems (Cocksedge and Hobby, 2006). Thus, the more active phases of compatible management are consistent with extensive, intensive forest farming systems, as both resource types are explicitly managed for.

Compatible management activities that might be regarded as extensive forest farming activities reported in British Columbia include integrating conifer foliage collection with pruning and juvenile spacing, managing and studying the effects of silviculture and/or zoning on mushroom productivity, controlled burns for specific species regeneration, riparian area restoration with species of economic importance, thinning and spacing to enhance the understory, targeted brushing to enhance noncompetitive brush species, partial harvests, and longer tree rotations for mushroom production.

General Definitions and Descriptions

During the early development of forest farming, the primary plan was to increase and diversify the productive capacity of woodlands. Instead of producing only timber and other wood products, the desire was to include a wide range of foodstuffs and other raw materials. The early concepts integrated forestry with farming, animal husbandry, and horticulture to achieve maximum output and optimum conservation (Sholto and Hart, 1985). These visionaries maintained that a fully applied forest farm integrated three main components—trees, livestock, and forage. The trees would provide timber and associated products. They would help to conserve soil and ameliorate climatic stresses. The livestock, products in themselves, would be nurtured by the favorable environment produced by the trees. Each component when fully integrated became essential elements of a whole ecosystem. Early discussions of forest farming included integrating livestock production, although by current definition this is excluded from forest farming and is discussed under silvopasture (see Sharrow et al., Chapter 6 of this volume).

According to Sholto and Hart (1985), forest farming combines the ecological stability of natural forests with the higher productivity of agricultural systems. It is most appropriate for marginal lands that are not suited to intensive agriculture. These lands typically support the lowest income farm families and communities. Sholto and Hart submit that forest farming is relevant to a large segment of America's landowners and contend that forest farming is the "tool" with the greatest potential to feed people and animals, to regenerate the soils and restore aquifers, to control floods and drought, and to create microclimates that are more beneficial and lead to more comfortable living conditions.

Forest farming involves the cultivation or management of understory crops within an established or developing forest (University of Missouri Center for Agroforestry, 2006; Agroforestry Research Trust, 2007; Center for Subtropical Agroforestry, 2007; Cornell Cooperative Extension, 2007; National Agroforestry Center, 1997). It is a type of agroforestry, a forest land management system that integrates agriculture and forestry on the same landscape. Forest farming may take place in a natural forest setting or in a more organized plantation and can be a sustainable production system that helps keep a forest healthy by introducing more diversity to the

landscape. These systems represent integrated management of timber and non-timber forest crops. Management may range from intensive cultivated systems in which plants are introduced into the understory of a timber stand to extensive approaches in which forest stands are modified to enhance the marketability of existing plants.

Non-Timber Forest Products

A variety of terms have been used to describe the multitude of products that come from forests that are plant based but not timber based. Words commonly used to describe the products include, but are not limited to, secondary, minor, special or specialty, non-wood, and nontraditional. To be globally effective, the student of forest farming must be aware of and understand the many terms used to describe forest farming products.

In many cases, the terms do not accurately or adequately describe the products. Often, the products are neither minor nor secondary, but are major components of rural household economies. Frequently, they are commodities, marketed in large volumes and at low prices, as opposed to specialty products that are typically sold in small quantities at premium prices. The collection and use of some products have a longer tradition in human society than the cutting of timber. For example, hunters and gatherers collected berries and other edible products from the forests long before they had the technology to cut timber. In some cases, they are produced from wood collected from the forest. Whatever the term used, it is important to understand the nuances of each.

According to the Food and Agriculture Organization of the United Nations (2007), non-wood forest products are products of biological origin other than wood derived from forests, wooded lands, and trees outside forests. Non-wood forest products may be gathered from the wild, or produced in forest plantations, agroforestry schemes, and trees outside forests. Examples include products used as food and food additives (edible nuts, mushrooms, fruits, herbs, spices, condiments, aromatic plants, game), fibers (used in construction, furniture, clothing, or utensils), resins, gums, and plant and animal products used for medicinal, cosmetic, or cultural purposes.

The USDA Forest Service defines *special forest products* in the national strategy as products derived from biological resources collected in forests, grasslands, and prairies for personal, educational, commercial and scientific uses. Special forest products exclude sawtimber, pulpwood, cull logs, small roundwood, house logs,

utility poles, minerals, animal parts, rocks, water, and soil (USDA Forest Service, 2001).

In 1999, the U.S. Congress passed legislation recognizing the importance of forest botanicals and requiring that more effort be made to manage for these products. For the purpose of Section 339 of H.R. 2466, Congress defined *forest botanical products* as naturally occurring mushrooms, fungi, flowers, seeds, roots, barks, leaves, and other vegetation (or portion thereof) that grow on National Forest System lands. The term does not include trees, except as provided in regulations issued under this section by the Secretary of Agriculture (H.R. 2466, 1999).

A more common and widespread term is *non-timber forest products*. This term relates to plants, parts of plants, fungi, and other biological material that are harvested from within and on the edges of natural, manipulated or disturbed forests. Non-timber forest products may come from natural forests, as well as from plantations. They include fungi, moss, lichen, herbs, vines, shrubs, or trees. Many parts are harvested, including the roots, tubers, leaves, bark, twigs and branches, fruit, sap, and resin, as well as the wood. They may be processed into finished products, such as carvings, walking sticks, jams, jellies, tinctures, or teas. They are classified in many different ways, but one common approach is to segment them into four major product categories: culinary, wood-based, floral and decorative, and medicinal and dietary supplements (Chamberlain et al., 1998).

Elsewhere, non-timber forest products may take on a broader concept. The Centre for Non-Timber Resources, a leading research and extension organization in Canada, defines non-timber forest products as all botanical (plant) and mycological (mushroom) species in the forest other than those that produce timber, pulpwood, shakes, or other wood products. The definition includes associated services such as tourism and education relating to non-timber forest products. Some groups in Canada, particularly First Nations (indigenous peoples), consider non-timber forest products to include forest animals. Animal products (e.g., "bushmeat" in Africa) are commonly considered non-timber forest products in other parts of the world as well.

One useful method of classification, categorizes these products along market segments. In the southern Appalachian hardwood forests, there are four major categories of products: edible and culinary, specialty wood, floral, and medicinal.

Edible and Culinary. Edible and culinary products harvested from the forests of southeastern

United States include mushrooms, ferns, and the fruits, leaves, and roots of many species. Perhaps the most commonly collected of the culinary forest products are ramps (*Allium tricoccum* Ait.), a wild onion that is one of the earliest spring emergents. Another important culinary species, black walnut (*Juglans nigra* L.), which is native to eastern United States, also is used in the medicinal and dietary supplement industry. Large populations of mushrooms and fungi can be found in western United States and parts of Canada. Honey also is considered an edible non-timber forest product.

Specialty Wood-Based. Wood-based non-timber forest products are produced from trees or parts of trees, but are not commercially sawn wood. For the most part, these products are destined for the craft segment of the industry. Some of the more important wood-based specialty forest products include the stems of sassafras (*Sassafras albidum* Nutt.) for walking sticks and willow (*Salix* spp.) stems for furniture. Vines, particularly grapevine (*Vitis* spp.) and smokevine (*Aristolochia macrophylla* Lam.) are used to make specialty wood-based products, as well as floral decorative products. A variety of hardwoods are used for carvings.

Floral Decoratives. Many forest plants and parts of plants are used in decorative arrangements, to complement and furnish the backdrop for flowers, as well as for the main component of dried ornaments. The end uses for many forest-harvested floral greens include fresh/dried flowers, aromatic oils, greenery, basket filler, wreaths, and roping, as well as craft items. Floral products from the oak ecosystems of southern Appalachia include various species of grapevine, kudzu (*Pueraria lobata* Willd.), and smokevine for wreaths and baskets; galax (*Galax urceolata* Poir.) for floral decorations; and twigs from several tree species. Several genera of moss are harvested from hardwood forests of Appalachia and used domestically and exported to the European floral industry. Included in this segment of the non-timber forest products industry are native plants used in horticulture and restoration (whole plant extraction).

Medicinal and Dietary Supplements. Forest-harvested plants used for their therapeutic value are marketed either as medicines or as dietary supplements. Plants that have been tested for safety and efficacy and meet strict U.S. Food and Drug Administration standards are marketed as medicines or drugs. According to Farnsworth and

Morris (1976), 25% of all prescriptions dispensed in the United States contain active ingredients extracted from higher order plants. Plants and plant products that do not meet the strictest FDA standards are marketed as dietary supplements in the United States. These products are legally considered food items, and product labels can make no claims about their medical benefits.

While categorizing plants in this way is useful and convenient, many species have multiple uses and may serve more than one market. For example, black cohosh (*Actaea racemosa* L.) is a popular medicinal plant also used in natural landscapes. Black walnut has many uses—the nut is edible, the shell can be used as an abrasive, and the extract from the shells and husks is medicinal. In the Pacific Northwest and British Columbia, salal (*Gaultheria shallon* Pursh) is used for its foliage (as a floral green) and for its berries as an edible forest product. Oregon grape (*Mahonia* spp.) is used in landscaping and as a floral green, while the berries are harvested for jellies and wines and the roots for natural dyes and medicinal applications (Pojar and MacKinnon, 1994). Organizing non-timber forest products into market segments does not preclude having specific species in several categories; a species may have multiple uses and therefore the potential for multiple products.

Why Forest Farming?

Forest farming has advantages and disadvantages over conventional forestry or farming (University of Missouri Center for Agroforestry, 2006). Forest farming can lead to improved forest health by increasing biological diversity, removal

of damaged and infected vegetation, and more active management of forest resources. It can result in additional and diversified forest income opportunities by producing products for more markets with greater diversity. At the same time, forest farming requires more intensive management, which demands greater skills and more time. The markets for many of the products may be less than adequately understood by the landowner, increasing the need for more research and assistance. Often the task of learning about and entering new markets is daunting to forest landowners. The integration of forestry and farming with new plants requires broader knowledge to encompass the growing and management of trees, understory crops, and their interactions.

Overall, many of the reasons producers might adopt a forest farming system are the same as or similar to why they might invest in any agroforestry system. System choices depend on the people, expertise and interest resources, as well as land and financial resources. In some cases, the system chosen will be designed to address a specific ecological function or to mitigate a perceived concern. By diversifying crops, products, production cycles, and land management systems, the forest farmer may be able to both reduce financial risk and generate environmental, cultural and recreational benefits.

Adopters of this diversified land use system can realize economic, ecological, and social benefits (Table 9–1). The economic benefits range from added income from new crops that provide interim income while longer-term crops mature to improved revenues from lands that are marginal for more traditional agricultural production. Additionally, labor requirements may

Table 9–1. Potential benefits of forest farming systems.

Economic
<ul style="list-style-type: none"> · New crops that can increase and diversify production and cash flow, decreasing dependence on single commodities. · Introduction of crops that provide short-term income while long-term crops mature. · Diversification of labor, potentially increasing the length of time labor is needed and increasing chances of retaining trained labor year after year. · Potential for short-term income derived from carbon sequestration and offset carbon credit accounting mechanisms. · Managing lands may have property and income tax advantages (e.g., managed forest or agricultural lands designation in B.C., and the Williamson Act in the U.S). · Potential to improve revenues from marginal lands that otherwise would be minimally productive. · Potential for paid government programs (e.g., USDA-NRCS) that may be compatible with forest farming.
Ecological
<ul style="list-style-type: none"> · Protection from or remediation of environmental concerns (e.g., sediment interception, interception of nutrient rich ground and surface waters, reduced impacts of flooding, reduced wind erosion, aid in snow capture, etc.) · Filter effect for noise, dust, odor, and light. · Enhancement of wildlife habitat, biodiversity, and aesthetics. · Ecological aspects of increasing carbon sequestration through changes in management practices.
Social
<ul style="list-style-type: none"> · Social aspects of improving environmental stewardship, biodiversity, and carbon sequestration. · Community and sector aspects of enhanced stability through diversification of products and production cycles. · Use of agroforestry systems as planning tools, which aid communities in connecting to resource systems and use of buffers to reduce urban–rural conflict.

be diversified as new crops can have different growth and productive time frames. Ecological benefits may be realized as a greater diversity of plants may be grown or nurtured under the forest canopy. Water quality and quantity may be enhanced, which improves resources for aquatic fauna. Overall, forest farming can provide both economic and conservation incentives, thereby enhancing environmental stewardship and community development.

Possible Adopters of Forest Farming

There are a growing number of private forest landowners in North America who are taking a nontraditional, comprehensive, and diversified approach to managing their woodlands. Managing the forest for timber may be a small or nonexistent component in their plans. Their major objectives may include managing the forest for recreation and to enjoy its natural beauty, protecting wildlife and fauna, keeping the forest healthy, and growing non-timber products for personal use, and for some, making a profit. There are three general categories of people who pursue this approach: new landowners who purchased the land because it was beautiful; people who have inherited the land but did not grow up managing it for timber; and, long-time forest landowners who are looking for alternative income opportunities.

New landowners often look at their forest as a prized possession that needs to be treated with great reverence. They want to keep it healthy and encourage a wide diversity of plants, animals, and fungi to live there. They like to, or think they would like to, grow their own food, make their own medicine, and live close to nature. Growing mushrooms, collecting herbs, and making dyes from plants are part of the lifestyle they strive to achieve. Making an income from the forest is usually not a primary goal.

People who inherit their land often do not know how to manage the forest or want to do it differently than their ancestors. Making an income from the forest is usually important. They at least need to make enough to pay the taxes so they don't have to sell the land. Many of these people have interesting experiences and educational backgrounds that lend themselves well to starting new, innovative businesses based on non-timber forest products.

Many long-time forest landowners want to diversify their income opportunities beyond timber. Recreational uses and production of shrubs, nut trees, and other crops similar to trees are often attractive to them. Making an income from the land is critical. This group is usually well grounded in

understanding what is practical, but they may be challenged by the marketing aspects.

Looking for Opportunities

Landowners interested in pursuing forest farming need to examine all internal and external factors that could influence their success. Many new enterprises may require additional skills and expertise. There may be additional capital or labor investments for which landowners will need to budget. The competition in some markets (e.g., edible mushrooms, Christmas trees, and bees) may be such that the profit margins make these alternatives less attractive. Interested landowners need to examine the markets and fully understand the potential and pitfalls of each possible venture. Although there are many challenges of developing forest farming, a diversified land use and management strategy can be economically rewarding to landowners willing to invest time and energy.

Marketing Forest Farming Products

Marketing is a much more involved process than simply letting a buyer know you have something to sell. Rather, it is the process of planning and implementing a strategy that includes everything from idea development, pricing, promotion, and distribution of what you are offering, right through to the exchange of your product for money. Much of the following discussion about marketing was drawn from an extension note prepared by Ambus et al. (2007).

As is the case for producers in any business, effectively marketing forest farming products is what makes the difference between the success or failure of an operation. In this section, we describe different approaches to generating revenue from forest farming products and services (for greater detail see Gold et al., 2009, Chapter 11 of this volume). Before undertaking a new initiative with significant investments, producers should take the time to develop detailed marketing and business plans. A well thought-out marketing strategy will help focus objectives, distinguish products from others, and improve bargaining positions.

There are four main ways to generate revenue from forest farming products and services: marketing commodities, marketing value-added products, marketing services and experiences, and charging fees to harvest.

Marketing Commodities

There are a wide variety of potential products that can be marketed and sold as commodities

from forest farms. Medicinal herbs, edible products (e.g., mushrooms, berries), decorative greenery (Christmas greens and others), and live plants are just a few examples of products that can be sold into commodity or raw material markets. Pricing for commodities can range from relatively stable to significant fluctuation, depending on supply and demand, including supply from other parts of the world where similar species grow.

Selling commodities may be the simplest way to enter the market—and is potentially less risky than other approaches—but may not always provide the best returns. In areas where there are buyers in reasonable proximity, selling raw products is an easy way to become familiar with the sector and with the demands of the market for product quality. Production information will be plant- and/or region-specific, offering opportunities to test and adapt available information to new regions. Similarly, marketing principles are highly portable, thus producers may learn as much from another producer or resource professional across the country as from someone located within their province or state. An essential step before entering production is to develop a clear picture of the industry in which you intend to participate. In brief, this involves focusing on:

1. Knowledge of product standards:
 - the form in which products are sold
 - requirements for product handling
 - minimum or preferred purchasing volumes
2. Awareness of external influences:
 - fluctuations in markets—regional, national, and international
 - effects of climatic variables on local supplies
 - seasonal purchasing trends
3. Anticipation of industry trends:
 - expected long-term market growth or decline
 - development of new product areas
 - pricing directions, shifts, and swings
 - new varieties or cultivars for production

As your marketing plan develops, it may be wise to refine your plans based on perceptions of which options have the best potential in the marketplace. When selecting a list of marketable “best bets,” consider:

- Are there buyers nearby?
- What is the demand for the crop, relative to supply?
- How does harvesting and selling these crops fit in with the rest of your production system? For

example, will the crop(s) require big inputs of labor during an already busy time?

- Is your investment (land, labor, and capital) likely to provide an adequate return?
- How does that return compare with other possible crop/product options?

In the end, you may determine that selling bulk commodities does not provide the returns you are looking for. Rather than abandoning the idea of producing a crop, it’s worthwhile to take the time to explore the potential value-added opportunities that may be available and may provide the return on investment you want.

Marketing Value-Added Products

When making decisions about your choice of products and how you can market them, consider ways to add value. Adding value will allow you to obtain a better price for the same amount of raw material. For small landowners, adding value to crops (whether agricultural or non-timber) can make a significant difference to the bottom line.

Value can be added to raw products in two general ways (Small Woodlands Program of British Columbia, 2001), either by changing the form of the product (e.g., grading, drying, canning, freezing) or by selling further along the marketing chain (i.e., to a retail outlet rather than to a wholesaler). Apart from gaining an increase in price for the same volume of raw materials, processing raw materials can provide other benefits, including:

- being able to sell some products out-of-season or over a longer period of time (e.g., berries which often all become ripe at the same time), minimizing the need for cold storage and reducing losses during the shipping of fresh products over long distances
- differentiating product using the same primary material to create a “niche” market

Many edibles that can be produced in forest farming also have a market in a value-added form. Fresh products are usually perishable and only available for short periods. Processing extends the period during which products can be made available, and allows processors to increase potential returns.

Greater profits are often achieved by adding value, but there are also greater risks, including increased requirements for investment in plant and equipment, training, operating capital, market research, etc. Prices are higher further down the marketing chain, but it may also take a good

deal of time to find and sell products to a large number of retail enterprises, rather than to a single broker or processing plant. It is important to be aware of complications that come with making processed food products. Carefully examine health regulations and standards as part of your market research.

Because forest farming products are so diverse, it is important to think about the specific markets for each type of product. The markets for food products such as jams, jellies, and syrups are different than those for floral products or craft items. Especially for processed goods, such as jams, jellies, Christmas wreaths, or twig furniture, it is useful to research the markets for handcrafted and specialty items in related industry sectors. What are the trends and prices for organic foods, for example? What are gardeners buying? Where are Christmas decorations sold? On the other hand, some types of outlets such as farmers' markets or craft fairs may offer opportunities to sell a wide range of products. Many small-scale non-timber forest products processors get their start at these types of events. Building on current product lines can also be a useful strategy—producers of Christmas trees might consider expanding their product line to include cut boughs, Christmas wreaths, or garlands, for example. If you are selling firewood, you could consider also selling fire starter cones made from cones dipped in paraffin wax and packaged as gifts. Other creative ways for adding value to edible (or other) products include direct marketing to consumers. In addition to the more traditional farm stands or farmers' markets, there are also options for supplying consumers with agricultural products through community supported agriculture (CSA) programs.

Useful information for producing and marketing value-added products is available from many sources that deal with general industry categories, such as food processing and landscaping. Other resources to consider when searching for information include business planning resources, industry associations, governmental agencies (local, provincial, state, federal), and not-for-profits and universities or colleges. One can also review more general information sites such as ATTRA, The National Sustainable Agriculture Information Service (ATTRA, 2007). More forest farming examples from British Columbia include *A Guide to Agroforestry in BC* (Small Woodlands Program of British Columbia, 2001) and a new series of handbooks from the Centre for Non-Timber Resources at Royal Roads University. Publications on floral greens and wild

foods are currently available (Centre for Non-Timber Resources, 2007a, 2007b). Examples from the United States include publications from educational institutions (e.g., Center for Agroforestry, University of Missouri) and the USDA (e.g., Thomas and Schumann, 1993; Vance and Thomas, 1997). As with any business venture, you will have to do the research, consider your resources, and “crunch the numbers” to determine if a specific idea for adding value is worthwhile.

Marketing Services and Experiences

Small tenure holders can learn from the growing “agri-tourism” industry. For the growing population of well-educated, well-off urbanites, rural life, rural skills, and rural products can exert a powerful pull. Depending on location, many forest farms may have good potential to provide amenities and services for local communities and visitors. As many small tenures are located near population centers, they are in a good position to capitalize on this market through, for example, mushroom and berry picking outings and festivals, visits to a birch or maple forest for “sugaring off,” cut-your-own Christmas trees with hot cider and perhaps a wagon ride offered as well. Classes and instruction in making wreaths, rustic furniture, floral design with wild plants, gourmet cooking with wild and local foods, or other crafts are also popular in many places.

Guided experiences on your forest farm are another example of adding value to your resources. On a straight value for weight of product harvested, there is no question you will be making considerably more than you could ever hope to make selling the produce without the experience to go with it. Festivals also hold potential for capturing more value at the local level by combining a number of activities to draw people in. The organization required to run a successful festival is significant, but so can be the returns. Berry festivals, wild mushroom festivals, and herbal gatherings have met with success in various locations. There is also the possibility of organizing a fall harvest festival where forest farm products could play important roles. Often one specific product is the focus of a festival, but the spin-offs for the community are much greater than created by the single resource.

Charging Fees to Harvest

Forest landowners may have opportunities to charge fees to others to harvest products or use services provided by the tenure holder (e.g., trails or other amenities) if they have desirable forest-based goods and services and are able to legally restrict access to these products or services.

In the Pacific Northwest of the United States where government landowners are authorized to charge fees for harvesting non-timber forest products, permits and other fees for non-timber forest product harvesting are quite common (Tedder et al., 2002). In British Columbia, some companies with privately owned forest land (e.g., TimberWest) and the Nisga'a First Nation (2007) charge harvester's fees to access products such as salal and mushrooms. Even if you are legally entitled to charge fees, however, it may not be economically viable to do so.

The likelihood that harvesters would be willing to pay for access depends largely on how much free access they already have in nearby areas. If you are close to a major population center, where forest lands are limited, or you produce scarce or especially high quality goods or amenities, the prospects are much better than if you are located in the midst of publicly accessible forest with similar attributes.

In most cases, any fee income would be modest. The potential depends on the commercial value of the products, and whether the tenure holder also can provide services that ease access, protection, security of supply, or trading. For example, exclusive access to private roads into high-value sites or a secure storage area might be appealing features to commercial harvesters. In any event, the introduction of fees or permits for harvesting resources that may historically have been freely accessible to all will require careful community awareness-building and advance discussion with users.

Many of the skills and interests necessary to successfully market forest farming goods and services may be quite different from those common in the production and marketing of timber and timber products. Partnerships—possibly with individuals and groups that are not in the forestry community—can be very beneficial. Consider, for example, contacting local garden clubs, chefs, craft groups, or floral designers. Products you consider as forest weeds may be just what they are looking for. Finding entrepreneurs who are interested in design and marketing may allow tenure holders to focus on production, while creating a new business opportunity that benefits both parties. Contact local charitable groups who may be looking for a novel fund-raising idea. Finally, spend some time and resources in looking at developing trends and opportunities in key areas where your forest farm has something to offer. If you want to develop your business, you need to recognize the importance of invest-

ing in market research for both short-term and long-term opportunities.

Market Outlook

Though no formal estimates have been made of the total value of the non-timber forest products markets in North America, available data illustrate the economic importance of some individual products. For example, in 1995, the United States exported moss and lichen, much of which was from southern forests, valued at more than \$14 million (Goldberg, 1996). In 1996, collectors of the fruit of black walnut, which is found in eastern hardwood forests, were paid more than \$2.5 million (personal communication, J. Jones formerly of Hammons Products Co., Stockton, MO). One company in southwest Virginia specializing in pine roping had sales in excess of \$1.5 million in 1997 (Hauslohner, 1997). Volunteer fire departments in western North Carolina generate from 30 to 90% of their budgets from annual ramp festivals. Based on 2001 prices, the average wholesale value of forest-harvested ginseng in a four-state region of Appalachia exceeded \$18.5 million. Certainly, the aggregate value of non-timber forest products to the southern economy far exceeds these examples.

In the early 1990s, bumper crops of edible mushrooms appeared on many National Forests in Oregon and Washington (Freed, 1994) as a result of major forest fires and spurred an increased interest in these alternative forest products. Schlosser and Blatner (1995) estimated the wholesale value of wild edible mushrooms in Washington, Oregon, and Idaho at \$41.1 million. They estimated that in 1992 buyers of mushrooms in the Pacific Northwest purchased \$20.3 million of product from more than 10,000 harvesters.

The floral industry relies heavily on products gathered from the forests. An early study of the floral greens and decoratives segment of the non-timber forest products industry revealed that these businesses contributed more than \$128.5 million to the economy (Schlosser and Blatner, 1994). The study found that buyers in western Washington and Oregon, and southeastern British Columbia purchased \$38 million worth of floral greens and \$9.6 million of boughs in 1989. Bough collection, for holiday wreaths, is a major economic activity in the northern states of Wisconsin and Michigan. Galax, an evergreen groundcover, has been harvested from the forests of western North Carolina and southern Virginia since before the 20th century. The primary source of this important floral product is seven counties in western North Carolina, where millions of leaves are harvested annually. Pickers

are paid by the leaf and can earn \$50 to \$120 for a box of 5000 leaves (Predny and Chamberlain, 2005). By some estimates, galax harvesting contributes multi-millions of dollars to the local economy (Greenfield and Davis, 2003).

The findings of medical research have helped to increase market demand for non-timber medicinal forest products (Eisenberg et al., 1993; Le Bars et al., 1997; Stix, 1998). The 1996 estimated value of the global markets for herbal medicines was approximately \$14 billion (Genetic Engineering News, 1997), of which Europe and Asia represented more than 80% of the global trade. In 1998, the total retail market for medicinal herbs in the United States was estimated at \$3.97 billion, more than double the estimate for North America in 1996 (Brevoort, 1998; Genetic Engineering News, 1997).

In the late 1990s, the mass-market segment for herbal medicinal products, approximately 17% of the U.S. market, grew at an annualized rate of more than 100% (Brevoort, 1998). Exports of forest-harvested ginseng from 1993 through 1996 grew more than 300% (USDA, 1999). Although exports of forest-harvested ginseng decreased in 1997 and 1998, demand for other species increased (USDA, 1999). For example, the estimated growth in the mass market for St. John's wort (*Hypericum perforatum* L.) and black cohosh for the 52-wk period ending 12 July 1998 was approximately 2800 and 500%, respectively (Brevoort 1998).

In Canada, there are no accurate and comprehensive estimates of the current and prospective values of non-timber forest products, whether wild-harvested or produced in forest farming systems. Wetzel et al. (2006) estimated current output of forest-based foods to be Can\$1.33 billion, with potential to expand to Can\$5.4 billion, including both wild-harvested and forest-farmed products. de Geus (1995) estimated that more than 200 products were commercially harvested in British Columbia in 1995. Wills and Lipsey (1999) estimated direct revenues from non-timber and ecotourism related activities at approximately Can\$280 million.

The Centre for Non-Timber Resources (CNTR) estimated the economic value of the trade in wild mushrooms and floral greenery (Cocksedge and Hobby, 2006). In 2006, the value wild mushrooms collected from British Columbia ranged from Can\$10 million to Can\$42 million for the past decade, with an average annual value of Can\$29 million. Based on current trade statistics, it is estimated that the export value of pine mushrooms during the decade of 1995 through 2005 ranged from Can\$6 million to Can\$32 million.

The value of chanterelle mushrooms (*Cantharellus* spp.) ranged annually between Can\$1 million and Can\$6 million. The export value of the floral greens sector was estimated to range from Can\$27 million to Can\$65 million for the past 5 yr, with an average annual value of approximately Can\$40 million. This composite picture supports the overall estimates provided by Wills and Lipsey (1999). The significant variation in values provides a strong indication of the important effects of both changing environmental conditions and the impact of global production and prices.

Estimates of non-timber forest product value are not based on consistent or reliable data collection of production and values. Few non-timber forest products, apart from a few specific products such as maple syrup and blueberries (*Vaccinium* spp.), are tracked regularly, and the values of those that may have more regular reporting are likely underreported, since most wild harvesting is documented poorly or not at all.

Edible Forest Products

Most people don't think of the forest as a source of vegetables, but there are a surprising number of plants that have been traditionally consumed by people who live in or near the woods. Edible and culinary products that can be farmed in the forests of North America include mushrooms, ferns, and the fruits, leaves, and roots of many species. Most of these are not sold in supermarkets, and only a few can be found for sale at roadside stands. But every year, people forage these plants from the woods and share them with their friends and family. Within the past few years, the growing wild foods movement has created a small commercial demand for these unusual and tasty plants. Some have been highlighted on cooking shows and in gourmet magazines. Many are sold online. You will probably be surprised at what you find if you search the internet for the term *wild foods*.

There is potential to make a profit from cultivating some forest vegetables, but understanding the markets is critical. Only a small percentage of the public will buy these products, but those who do are devoted customers who will return year after year. This group includes wild food enthusiasts, people who grew up eating these foods, gourmet cooks, and high-end restaurant chefs. The average consumer will stop and look at these with interest, but probably won't buy. To be successful, you will have to find a way to tap

into the market. Local food campaigns and the internet are obvious places to start.

Forest Farming for Wild Vegetables

There are many forest vegetables that have potential for forest farming. Most are wild-harvested for personal use or local sales. One of the more popular forest vegetables in eastern United States is the ramp (*Allium tricoccum* Ait.), a member of the onion family that is closely related to leeks. There are only a few enterprising landowners in the United States that are growing ramps for commercial sale. In response to rising consumer demand and concern for the conservation of the species, research on production and marketing of ramps was initiated at North Carolina State University in 1998. According to Greenfield and Davis (2001), ramps are native to the eastern North American mountains and can be found growing in patches in rich, moist, deciduous forests and bottoms from as far north as Canada, west to Missouri and Minnesota, and south to North Carolina and Tennessee. In early spring, ramps send up smooth, broad, lily-of-the-valley-like leaves that disappear by summer before the white flowers appear. The bulbs have the pleasant taste of sweet spring onions with a strong garlic-like aroma.

As one of the first plants to emerge in the spring, ramps were traditionally consumed as the season's first greens. They were considered a tonic because they provided necessary vitamins and minerals following long winter months without any fresh vegetables. Traditions evolved around the annual gathering and preparation of this pungent plant. Annual spring ramp festivals are held in communities throughout the mountains of the eastern United States. These festivals have become major tourist attractions and are promoted by the communities in which they are held. The tremendous volumes of ramps that are consumed at these festivals are gathered from the forests. Studies in Canada and Ohio have demonstrated that ramps are very sensitive to how they are harvested.

In recent years, high-end restaurants have begun serving ramps, increasing the demand for large, consistent supplies of the wild forest plant. In an effort to conserve native populations and meet rising demand, forest farming of ramps is strongly encouraged. Harvesting ramps from easily accessible, concentrated plantings would not only benefit festival participants, chefs, and consumers, but also create a new marketable product for the commercial grower.

In the southeastern United States, ramps begin growing rapidly in March and early April in cool,

shady areas with damp soil and an abundance of decomposed leaf litter or other organic matter. The plants produce new leaves in March to April, which die back as the forest canopy closes with new leaves. In June, after the leaves die back, a flower stalk emerges. The flower blooms in early summer and the seeds develop in late summer. The seeds mature atop a leafless stalk and eventually fall to the ground to germinate near the mother plant. The timing of these events is usually delayed at high elevations and in locations north of North Carolina and Tennessee.

Ramps grow naturally under a forest canopy of beech (*Fagus* spp.), birch (*Betula* spp.), sugar maple (*Acer saccharum* Marsh.), and/or poplar (*Populus* spp.). Other forest trees under which ramps will grow include buckeye (*Aesculus* spp.), linden (basswood) (*Tilia* spp.), hickory (*Carya* spp.), and oak (*Quercus* spp.). A forested area with any of these trees present provides an ideal location for planting a ramp crop. Areas that host trillium (*Trillium* spp.), toothwort (*Cardamine* spp.), nettles (*Urtica dioica* L.), black cohosh (*Actaea racemosa* L.), ginseng (*Panax ginseng* C. Meyer.), bloodroot (*Sanguinaria canadensis* L.), trout lily (*Erythronium umbilicatum* Parks and Hardin), bellwort (*Uvularia*), and mayapple (*Podophyllum peltatum* L.) should be suitable for growing ramps. If there is not a wooded area available to grow ramps, a shade structure can be erected over the planting site.

Greenfield and Davis (2001) recommended growing ramps on well-drained sites that have rich, moist soil with high amounts of organic matter. Soil moisture appears to be an important environmental variable influencing seed germination, seedling emergence rate, survival, and growth rate of the plant. Thus, adequate moisture must be maintained throughout all seasons, not just the active growing season. The growth period for ramps is limited to only a few weeks in the spring, during which time the plant is dependent on having adequate light, moisture, and nutrients for survival.

Although ramp seeds can be sown any time the soil is not frozen, late summer to early fall is usually considered the best time for seeding ramps. Fresh ramp seeds have a dormant, underdeveloped embryo. The seed requires a warm, moist period to break root dormancy and a subsequent cold period to break shoot dormancy. Some years there is enough warm weather after sowing in late summer or early fall to break root dormancy. The following winter, cold breaks shoot dormancy and the plants emerge in spring. If there is not an adequate warm period after

sowing, the seed will not germinate until the second spring. Thus, ramp seeds can take 6 to 18 mo to germinate. For example, in Fletcher, NC, ramp seeds that were sown in the fall of 1999 and spring of 2000 all germinated in April 2001 (Persons and Davis, 2005). Being able to provide adequate soil moisture and protection from wildlife are other key factors in determining where and when to sow seeds. Production from sowing seeds to root harvest can take 5 to 7 yr.

To plant under a forested canopy, rake back the leaves on the forest floor, removing any unwanted weeds, tree sprouts, or roots. If the soil is not naturally high in organic matter, incorporate organic materials such as composted leaves and other decaying plant material from the forest. Loosen the soil and rake to prepare a fine seed bed. Sow seeds thinly on top of the ground pressing them gently into the soil. Cover seeds with several inches of leaves to retain moisture in the soil and to protect the seeds from wildlife. In a field site under artificial shade, add organic matter if needed, till the soil, sow the seeds, and cover with composted leaves or other similar natural materials.

Many growers prefer planting bulbs or young plants instead of sowing seeds. Since germination of the seed can take up to 18 mo, transplants and bulbs can be a good alternative for the beginning ramp grower. Planting large bulbs can provide harvestable ramps within 2 to 3 yr. Bulbs can be purchased in February and March or dug for transplanting between September and March, with February to mid March being the best time. March is the best time for transplanting young plants. If bulbs are to be dug for transplanting, once the ground has thawed, gently dig the ramps, taking great care not to damage the roots or bulbs. In a prepared planting bed, transplant the bulbs approximately 7.6 cm (3 in) deep, and 10.2 to 15.2 cm (4 to 6 in) apart, allowing all the roots to be buried and keeping just the very tip of the bulb above the surface. Planting bulbs at the proper depth is important for survival. Transplant leafed-out plants at the same depth they had been growing and space 10.2 to 15.2 cm (4 to 6 in) apart. If space is limited, clumps of four or five plants can be grouped together. Mulch the planting bed with at least 5 to 7.6 cm (2 to 3 in) of leaf litter.

Hardwood leaves provide the best mulch for ramps. Poor results have been obtained with pine bark and commercial mulches and they should be avoided until further research is done. The effects of mulching are numerous: decaying organic matter provides essential elements

like nitrogen, much needed moisture is retained within the mulched area, and the mulch acts as an insulator to protect the plants in sub-zero temperatures. In addition, mulching helps to suppress weeds as well as protect newly sown seeds and seedlings from wildlife.

In native populations, ramps usually form extensive colonies or patches. Often the bulbs are so densely spaced that other vegetation can hardly penetrate the stands. Methods for harvest include digging the whole patch, harvesting a portion of a patch, or thinning out and harvesting just the largest plants. Do not harvest plants until they have filled the site, have large bulbs, and have flowered. If whole plots are harvested at one time, it is recommended to have enough patches to allow for a 5 to 7 yr rotation. That is, to have an annual harvest year after year, harvest only one-fifth or one-seventh of your production area each year. When harvesting a portion of a plot, no more than 15% of the ramps should be removed. If the thinning method is used, great care should be taken not to damage plants that are not harvested. Harvests of wild populations should be limited to 5 to 10% of the plants in each patch.

Tools for harvesting ramps vary. A ramp “digger” tool can be purchased or made. This hand tool is the size of a hammer, with a long, narrow head similar to a mattock. Other suitable tools include a garden hoe, pick, and soil knife. For commercial operations, having a tool that can be used comfortably all day is essential.

Digging methods are the same as those described for transplanting. Again, great care should be taken not to damage the bulbs. While harvesting, keep the dug ramps cool and moist. When harvesting is complete, wash ramps thoroughly, and trim off the rootlets. Pack in waxed cardboard produce boxes and store in a cool place, preferably a walk-in cooler. Do not store in airtight containers.

Very little information is available on disease or insect pressures on ramps. In North Carolina and Tennessee, *Septoria* leaf spot has been observed in wild and cultivated ramps. Although the spot was unsightly on the foliage, it did not appear to adversely affect plant yields in 2001 (Persons and Davis, 2005). The long-term effects of the disease are unknown. New ramp plantings do not compete successfully with weeds; thus, weeds should be controlled until the plants are well established.

Other Forest Vegetables

There is an abundance of edible plants that may have potential markets. Many plant identification books include brief descriptions of or references

to historical usage (e.g., Pojar and MacKinnon, 1994; Johnson et al., 1995). Other sources provide more detailed information on edibility and uses. Some of the plants described below may be obscure, but they illustrate the vast potential of forest vegetables that can be farmed in the forest, if even just for personal use. The fact that a plant is discussed below does not mean that it has a ready market. Also, forest farmers need to be concerned about introducing invasive plants or exploiting rare plants, as both have serious implications. These forest vegetables are illustrative of the vast potential. Much of the information provided here is derived from two online databases, USDA Plants Database (USDA, 2007) and Plants for a Future (2007).

Bean Salad, Rosy Twisted Stalk, Scootberry (*Streptopus lanceolatus* Ait. var. *roseus* Michx.). This native perennial can be found growing in moist wooded areas throughout much of eastern North America. The young leaves and shoots are used in salads or cooked as greens. The small, edible fruit has a melon flavor, but can be toxic if eaten in large quantities. The plant is easily propagated by seed or root division. This plant is listed as threatened, endangered, or of special concern in five states. Check on local regulations concerning cultivation and sale of the plant.

Bear Grass Spiderwort, Virginia Spiderwort (*Tradescantia Virginia* L.). This native perennial grows naturally in moist, shaded areas throughout the eastern United States and California. The young leaves and shoots are eaten raw in salads or cooked as greens. The attractive flowers are also edible. The plant also has a number of medicinal uses. Seeds can be started indoors and set out in the spring. Shoot cuttings root easily.

Branch Lettuce, Mountain Lettuce, Lettuce Leaf Saxifrage (*Saxifraga micranthidifolia* Haw.). This native perennial can be found in the Mid-Atlantic states. It is listed as threatened or endangered in two states, so check on local regulations before cultivating or selling it. Branch lettuce grows in moist soils in light shade to full sunlight. In some areas, this is a common spring time food. It is used as a salad green or cooked vegetable. A traditional meal would consist of branch lettuce fried in bacon grease with ramps or wild onions, pinto beans, and corn bread. It can be propagated by dividing the plants in early spring.

Burdock, Gobo (*Arctium lappa* L.). Introduced from Europe and Asia, burdock is a biennial

that can be found throughout North America. It grows in moist soil in light shade to full sun. Burdock is commercially produced in some areas for its root. Leaves, stems, and roots are edible. Very young roots can be eaten raw, but usually the roots are boiled, steamed, or sliced for a stir-fry. Young stalks and leaves are eaten raw or cooked. Burdock is also a very important medicinal herb. The plant grows easily from seed. Harvest first-year plants, because roots of 2-yr-old plants are woody. There may be some toxicity issues with burdock; the most commonly reported problem is skin sensitivity to the hairs on the seeds.

Dandelion (*Taraxacum* spp., esp. *officinale* G.H. Weber). This common perennial plant grows throughout North America in full sun and partial shade. Some species are native, and some are introduced. It is produced commercially as a salad crop. The raw leaves are tastefully bitter. The root can also be eaten, raw or cooked. The flowers are eaten raw or fried as fritters. Dandelion wine is popular, and a tea is made from roasted roots. Dandelion is a potent medicinal herb. This plant is easy to grow from seed, but definitely grows better in some areas than others. Dandelion can be weedy or invasive.

Dock, Yellow Dock, Curly Dock (*Rumex* spp., esp. *crispus* L.). This perennial from Europe, Asia, and Africa now grows throughout North America. It prefers partial shade, such as found at the forest edge. It is considered seriously weedy or invasive in some states. The young leaves can be eaten raw in salads or cooked like spinach. Also like spinach, it is high in oxalic acid, so eating large quantities may cause problems. Dock is also an important medicinal herb. This plant is very easily grown from seed.

Miner's Lettuce (*Claytonia perfoliata* Donn ex Willd). This annual native plant is widespread over western North America and is considered a weed in some areas. It grows in full shade to full sun. The leaves are eaten raw or cooked. It grows easily from seed and will readily self seed.

Nettles (*Urtica dioica* L.). This native perennial grows throughout North America. It is weedy or invasive in some states, and many people consider it an uncomfortable nuisance to have around. The plant has stinging hairs on the leaves that cause pain and irritation when touched. Yet, this plant has a reputation as being an ideal source of vitamins and minerals especially iron. It is a well known medicinal herb. The plant grows in the shade and in the forest edge. The young leaves are cooked and served as a green or added

to soups. The dried leaves make a pleasant tasting tea. Start seedlings in the greenhouse and set out in the spring.

Poke Sallet, Poke, American Pokeweed (*Phytolacca americana* L.). This tall, distinctive native perennial prefers to grow on the edges of the woods. Birds love the berries, but the raw plant is highly toxic to livestock and humans. It is, however, a highly desired traditional food in the South. Young leaves and shoots are gathered in the spring and boiled two times, discarding the water each time to get rid of the toxins. It is then boiled a third time till tender and seasoned with salt and fat back. The plant also has medicinal purposes. Similar to rhubarb, this vegetable should only be sold to people who understand its toxicity and how to prepare it. This plant can be found growing throughout most of North America. It can be very weedy and invasive. Although, it can be easily grown from seeds or divisions, poke is so prevalent, it can probably just be wild harvested and managed as such.

Sweet Salad, Solomon's Seal (*Polygonatum biflorum* Walt.). This native perennial can be found growing in moist, rich woods throughout most of North America. It can be weedy or invasive in some areas. Young shoots are boiled and eaten as a vegetable. It is easiest to propagate by dividing large plants in early spring or the fall.

Upland Cress, Creasy Greens, Creasy Sallet, Early Yellow Rocket, Or Early Watercress (*Barbarea verna* P. Mill.). This low-growing plant from Europe resembles watercress. It prefers to grow on the edge of the forest, in a moist, but well-drained site, where it gets some sun and shade. It is a perennial, but when grown as a salad plant is usually treated as an annual. The young leaves have a hot, spicy flavor. They are usually served cooked, but increasingly are being used raw in salads. In northern locations, seed can be sown in succession from spring through early fall for harvest over an extended season. In the South, seeds are usually sown during the fall for harvest in late winter and early spring (Sanders, 2001). At harvest, leaves may be cut for a 'cut-and-come-again crop' or the entire plant may be cut.

Watercress (*Nasturtium officinale* Ait. F.). This creeping small leaved perennial is native to Eurasia but can now be found throughout most of North America. It is a peppery-flavored salad herb, also used on sandwiches and in soups. Rich in vitamins and minerals, it has a long history of use as a medicinal herb. It likes to grow in clean, flowing streams or in very wet soil in

shaded areas. Young seedlings or cuttings can be planted in the spring. If grown in water, care must be taken to avoid infestation with parasites or other human pathogens. This plant is considered invasive in some areas and may be banned in some states.

Mushrooms and Fungi

Many edible mushrooms, such as shiitake (*Lentinula edodes* Berk.), maitake (*Grifola frondosa* Dicks.), lion's mane (*Hericium erinaceus* Bull.), and oyster (*Pleurotus* spp.) can be grown commercially in a forest farming setting. The shiitake mushroom is the most popular for small-scale cultivation. Production of shiitake in this country started about two decades ago, when demand exceeded the ability of importers to fulfill orders, and the technology for landowner production became readily available and simple. Rural development agencies began promoting shiitake mushroom production as an alternative income source for landowners. Many landowners started producing this valuable mushroom, and today it is well accepted in gourmet markets.

Shiitake mushrooms grow best on hardwood logs, cut from live trees in a moist climate ranging in temperatures from 18.3 to 23.9°C (65–75°F). Moderate temperatures and high humidity promote fast growth of the 'threadlike structures from which the mushrooms grow' (called *mycelium*). A forest stand that provides at least 60% shade is preferred for best production. If possible, select a mixed softwood-hardwood forest because the softwoods provide shade throughout the year and contaminants common to hardwood forests are less prevalent.

The first step in producing shiitake mushrooms is to select the best tree species for the logs. Shiitake mushrooms grow on white oak (*Quercus alba* L.), red oak (*Q. rubra* L.), ironwood (*Carpinus caroliniana* Walt.), alder (*Alnus* spp.), cottonwood and poplar (*Populus* spp.), as well as beech (*Fagus grandifolia* Ehrh.), and sweetgum (*Liquidambar styraciflua* L.). White oak logs work the best, although hard maple (*Acer* spp.) also works well.

Logs should be cut from living trees that have no decay. The best time to harvest the logs is during the dormant months, when the wood has the greatest amount of stored carbohydrates. The bark will remain intact longer if the logs are cut during the dormant months. They should be inoculated within two to 3 wk after felling. The longer cut logs are left uninoculated, the greater the chance that foreign contaminants will invade the logs and compete with mushroom mycelium, reducing yields.

Log length is not as critical as log diameter. The length should be determined by what is most easily managed by the person involved with moving them. In general, logs 0.9 to 1.2 m (3–4 feet) long and larger than 7.6 cm (3 in) in diameter work well. Smaller logs will dry out more quickly. Logs greater than 15.2 cm (6 in) in diameter may produce longer, but need more inoculations to compensate for the bigger diameter. It is important to retain the moisture content of the wood while keeping the bark relatively dry. If cut logs will not be inoculated for several weeks after cutting, they should be covered with a porous material (e.g., burlap, muslin) and watered regularly.

Logs are prepared to receive the *spawn*, a substrate that contains active mycelium, by drilling a diamond pattern of holes through the bark and into the sapwood. Holes should be drilled 15.2 cm (6 in) apart within rows along the length of the log, with 5.1 to 10.2 cm (2–4 in) between rows. The number of rows along the length of the log depends on the diameter of the log. In general, there should be one row less than the diameter in inches of the log. So, if a log is 15.2 cm (6 in) in diameter, there would be five rows of holes. The diameter and depth of the holes depends on the size of the spawn container and the amount of spawn needed.

The fungus is introduced by inoculating the logs with mycelium in the form of spawn. Suppliers may recommend cold, warm, or wide-ranging weather spawn, depending on local growing conditions. Spawn can be refrigerated for several weeks, but should be kept at room temperature for a few days before inoculation. Spawn is available in three forms: sawdust plugs, dowels or a pre-sealed plug that requires no wax at the inoculation site. To reduce possible contamination, spawn should be inserted into the holes immediately after the holes are drilled. Once the holes are filled, they should be sealed with hot wax (paraffin) or impermeable plugs to prevent drying. The ends of each log can be sealed with wax to reduce contamination and moisture loss.

After inoculation, the logs are stacked and protected from moisture loss to allow the fungus to spread. This incubation period takes from 6 to 8 mo and depends on the type of spawn, log size, moisture content of the log, and temperature. Protect the logs during the incubation period by providing sufficient shade (60–80%). Log moisture content should be monitored to prevent the logs from drying out. Logs should be stacked in a particular pattern; the lean-to and criss-cross are two common designs. Logs should not be

placed directly on bare soil but should be raised off the ground.

The spawn run is complete when white mycelia appear on the end of the logs. The fungi will fruit when the weather conditions are favorable, which typically occurs in the spring and fall. It is possible to force production by soaking the logs in water for 48 to 72 h; fruiting will begin in about a week. If left alone (not soaked), logs will produce over a longer time period, and produce about the same amount. As the optimal harvest time lasts only about 12 h, it is important to check for mushrooms daily. Once the logs begin to fruit, they will produce mushrooms a few times a year for up to 3 yr. After each harvest, the logs need 8 to 12 wk of rest to allow the mycelia to reproduce.

To create a weekly market for mushrooms, you should fruit one-twelfth of the logs weekly. Ideally, logs should be moved to a production house. Mushrooms will not fruit when temperatures exceed 29.4°C (85°F) or go below 10°C (50°F). To fulfill a weekly market, you should have a controlled environment building that can be heated and cooled to fruit the most desirable mushrooms.

Farming a forest for mushrooms can be lucrative, but successful commercial producers are those who market them well. The final decision to grow mushrooms as an alternative forest product should be based on economics. As markets develop and more people begin to grow mushrooms, profit margins decrease. The successful producer will figure out how to compete with established and experienced firms by finding niche markets and producing high-quality low-cost products. One option is to cut and sell logs to mushroom producers. Another is to market logs that are inoculated and allowed to age for 4 to 5 mo.

A search of the internet can help identify buyers of edible mushrooms. Large grocery chains rely on wholesale distributors for products and tapping into that segment may be difficult for small producers. It may be possible to sell to wholesale distributors, but direct sales to local restaurants and consumers through farmer's markets may prove more profitable to small entrepreneurs. To succeed in the edible mushroom business, the entrepreneur must find niche markets and differentiate their products from the many other mushroom producers.

Forest Farming for Bee Products

The land under forest trees can be used to raise honey bees (*Apis mellifera* L.). These beneficial insects provide valuable products when managed properly. A single hive can produce 176

to 265 kg (80–120 lb) of harvestable honey each year. Specialty honey products such as flavored honeys, packaged honey gifts, creamed honey, honey wine, and mead may command higher prices. Pollen, which contains high levels of protein and other nutrients, is used as a food additive, medicine, and in cosmetics. Beeswax is used in candles, cosmetics, foundation sheets for frames, and other assorted products. Wax is harvested from the cappings removed during honey extraction and from other broken combs in the hive. *Propolis* is a mixture of beeswax and resins from plants and is used in the hive to reduce the entrance, repair cracks, cap brood, and seal off intruders. Antibacterial properties of propolis make it useful in medicines, particularly for wound healing. Further, hives may be rented out to crop growers for pollination services.

Hives are made to standard dimensions and have several interchangeable parts. The outside of the hive should be painted to protect the wood. The hive's bottom board sits on blocks to keep it off the ground. Wooden frames with a beeswax foundation that is imprinted with hexagonal cells for the bees to build their comb are set in the hive body. A queen excluder is placed between the brood body and honey supers to prevent the queen from laying brood in frames that are harvested for honey. Honey supers are integral parts of the hive, having shallow frames for storage, and an inner cover that insulates the hive prevents bees from attaching comb to the outer cover and protects the hive from the weather.

Depending on the size of the colony, several supers may be needed. The brood is reared in the lower sections of the hive, honey and pollen are stored around the brood, and extra honey is stored in the upper sections of the hive. Two large hive bodies are placed on the bottom for the brood, and four shallow supers are placed on the top for honey. Interchangeable supers allow for excess honey to be harvested from the upper supers in the fall without disturbing the brood. Each super should contain at least nine frames with comb.

Additional equipment used in beekeeping includes a smoker to calm bees and reduce stinging, a hive tool to pry apart supers and frames that are connected with comb and/or honey, a veil and gloves to protect the head and arms from stings, and feeders that are filled with sugar syrup to feed bees in winter and early spring.

The best way to get started is to buy two established colonies from a reputable local beekeeper. Buying two colonies will allow the hives to be combined or interchanged if they become weak,

and is enough to gain experience handling bees before expanding. Hives need to be inspected and certified by the State Department of Agriculture to ensure that they are free of pests and disease. They should be moved in winter when the populations are low and the bees are less active.

Another option is to order packaged bees, which usually contain 9000 to 22,000 bees and a single queen that is enclosed in a small cage. The cage is plugged with cork at one end, and a white "queen candy." To set up the hive, remove half of the frames from the hive body, and then suspend the queen in the cage between two frames. The rest of the bees should be poured into the hive body around the queen. As they begin to settle down, the rest of the frames, the other supers and the cover are replaced. The workers will slowly eat the queen candy, releasing the queen from her cage. The hive should be checked after 2 d to make sure that the queen has been released, and the empty cage is then removed. A week later, the hive should be checked for the formation of comb and brood cells. If the queen has not started laying eggs, she may be dead and should be replaced.

Honeybees should be kept where they will have access to water and flowering plants and trees that produce nectar and pollen. Hives should be placed in a low-traffic area that is sheltered from wind and cold air and partially shaded. A southern or southeastern exposure with a windbreak to the north and deciduous trees for shade can help regulate temperatures around and inside the hive. Areas where bees will disturb neighbors or public areas such as parks and schools should be avoided.

Hives require year-round management. Treatment for pests and disease should be done in January and February. On warm days in mid-February (7.2°C [45°F] or higher), hives should receive a detailed inspection. The brood pattern and population growth should be checked and any signs of disease or pests noted. If a colony shows weak brood production, frames with a sealed brood from stronger nests may be inserted into the hive. If two hive bodies are used, they should be arranged so that the brood is contained in the lower brood chamber.

Honey supers should be added in early April during nectar flows. Bees store nectar in cells, and once it is evaporated to 18% moisture content, it is capped and finished. The color and taste of honey varies with the nectar source. Light colored honey, such as sourwood and orange blossom, have a more delicate flavor than darker

honeys such as tulip poplar, and they often command a higher price. The dates of nectar flow vary with different sources, so dark honey may be removed before lighter honey is produced.

Honeybees, brood, and hive equipment are susceptible to numerous pests and diseases. Varroa (*Varroa destructor*) and tracheal mites (*Acarapis woodi*) have killed about 90% of the wild and 60% of the commercial honeybees in the United States. Apistan (Tau-fluvalinate; Wellmark, Schaumburg, IL) strips are hung inside hives for 30 consecutive days in early spring and for 60 consecutive days in fall to treat mites. Tracheal mites are treated with Mitecur (Amitraz; Intervet, Millsboro, DE) or menthol formulations in edible oil-sugar patties in winter and early spring. Hives infected with American foul brood (AFB) must be burned to prevent the spread of the disease. European foul brood (EFB) is not as infectious as AFB. To prevent these infections, colonies can be fed the antibiotic Terramycin (Oxytetracycline; Pfizer, New York) in early spring and fall.

Additional pests and diseases include chalk brood, a fungus (*Ascosphaera apis*) that affects brood during damp conditions in spring; nosema (*Nosema apis*), a protozoan disease that affects adult bees in damp, cold conditions; wax moths (*Galleria mellonella* and *Achroia grisella*), which lay their eggs in the comb, particularly comb in storage; and the small hive beetle (*Aethina tumida*), an exotic pest that decimates comb with burrowing and feeding. Africanized honeybees, which are known as "killer bees," are indistinguishable from other bee races, but are more aggressive and willing to attack. Hives may be moved into but not out of areas infested with killer bees.

Proper management, including a schedule of preventative treatments, is needed to protect the colony. Hives should be inspected carefully for any signs of infestations to detect and treat problems as soon as they appear. Most treatments are scheduled for early spring before nectar flows or in fall after bees are finished foraging. Many treatments must be removed from the hive for a specified period before nectar flows begin. The USDA Beltsville Bee Research Laboratory provides free testing and laboratory analysis for various pests, diseases, and identification of Africanized bees.

Many states are requiring the inspection, certification and registration of beekeeping operations to help combat the movement of pests and diseases. Inspection is necessary to show that bees, combs, and hives are free of contagious and infectious pests and disease. In some states,

used beekeeping equipment, including hives, supers, combs, frames, or other appliances and supplies, may not be imported. Landowners interested in pursuing forest farming for bees should contact their respective state agriculture department to learn about pertinent regulations and restrictions.

Forest Farming for Syrups

In North America, tree sap has been used in a multitude of ways by native people and European settlers for centuries. Today, sap products have grown in importance, economically and culturally, and are a successful forest farming sector. Native people traditionally harvested the sugar maple (*Acer saccharum* Marsh.) for its sap to produce sugar, as a sweetener and as a condiment in soups and meats. Early European settlers learned to make sugar from the native people and over time developed syrup making methods. Early sap collection entailed boring holes in trees with augers and using wooden spikes to tap the trees and collect the sap in wooden buckets. The sap was then boiled in iron kettles and later, in flat-bottomed tin pans (Ramlal et al., 2007).

While the use of sugar maple is well established in eastern North America, there is also a history of native people using sap from big leaf maple (*Acer macrophyllum* Pursh.) and paper birch (*Betula papyrifera* Marsh.) (Turner, 1998). A specialty syrup industry associated with these species (Hobby et al., 2007) is beginning to emerge.

Sugar Maple

Sugar maple is widespread in mixed hardwood forests of eastern North America (Anonymous, 2000; USDA, 1997c; Tirmenstein, 1991; Godman et al., 1990). It grows from Nova Scotia to New Brunswick westward to Ontario and Manitoba, North Dakota, and South Dakota, southward into eastern Kansas and Oklahoma, and southward in the east through New England to Georgia.

Sugar maple grows in a wide variety of plant communities throughout eastern North America (Tirmenstein, 1991; USDA, 1997a). It is a dominant or co-dominant species in many northern hardwood and mesophytic communities. Sugar maple forms pure stands but also grows mixed with other hardwoods and scattered conifers. Common co-dominants include beech (*Fagus grandifolia* Ehrh.), birch, and American basswood (*Tilia americana* L.).

Sugar maples are very tolerant of shade (Tirmenstein, 1991; USDA, 1997b; Ontario Ministry of Natural Resources, 1995). They can survive in the shade of other species for years until an opening in the canopy occurs and they are released

to grow in partial or full sunlight. This factor makes sugar maple a good candidate for compatible management with other timber crops where it could be intercropped with coniferous species and/or other mixed hardwood stands to promote biodiversity while providing income possibilities between timber rotations.

As sugar maple can be managed either as pure or mixed stands, this allows the forest manager to plan multiple objectives of timber and non-timber opportunities and develop steady cash flows. The Small Woodlands Program of British Columbia (2001) reported that sugar bushes can be intercropped with longer-lived perennials and leguminous trees that enhance soil properties. Sugar bush growth is improved by the presence of nurse trees and logs that provide weed control, reduce wind and improve tree form, and can be harvested once the maple trees mature. Sugar bush stands are less compatible with other forest values such as crops that require flooding, or that require substantial sunlight, as well as the grazing of animals.

The sugar maple industry has evolved into a global market with annual worldwide production ranging from US\$68 to \$112 million from 1995 to 2004. Worldwide production in 2004 was estimated at about 42,783 metric tonnes of maple syrup with Canada accounting for about 82% and the United States the remaining 18% (AAFC, 2005). As the maple syrup industry is quite mature, entering this market may be challenging and requires finding a niche that has not been filled.

Bigleaf Maple

Bigleaf maple has been used in western North America by native people for various purposes including the wood for eating utensils, fishing lures, canoe paddles (Turner, 1998), as well as the sap as a tonic (Parish et al., 1996). There has been increased interest in developing a big leaf maple sap industry as many woodlot managers see potential to manage big leaf maple for timber and sap production. On Vancouver Island, there are about 300 sap harvesters that are experimenting with various specialty products including big-leaf maple syrup, maple wine, maple sap extract, and other sap products (Hobby et al., 2007).

Bigleaf maple has gained the attention of forest managers who recognize that the species has significant value for timber and sap. This presents a potential diversification strategy as former forest management strategies typically attempted to remove big leaf maple in favor of coniferous timber species. Managing bigleaf maple with traditional coniferous species may

be a better strategy than previous forest management approaches to maximize the highest and best use of the land.

Bigleaf maple has a natural range from California to British Columbia, where it is found on most of Vancouver Island and throughout the Lower Mainland of British Columbia. Typically, it does not occur farther than 300 km (185 miles) inland from the Pacific coast (Minore and Zasada, 1990). The species occurs primarily in the Coastal Douglas-fir and southern Coastal Western Hemlock climatic zones. On Vancouver Island, the species is often prominent in productive Douglas-fir ecosystems (Peterson et al., 1999; Pojar and MacKinnon, 1994).

Bigleaf maple prefers damp forest habitats and is frequently found along the edges of streams, on floodplains and seepage sites. It thrives in the porous, gravely soils of stream banks and grows best in high nutrient soils, especially those rich in nitrogen and calcium (Farrar, 1995; Packee, 1976; Minore and Zasada, 1990; Norse, 1990; Safford et al., 1990). It can be found in rocky and shallow soils, although growth is reduced under these conditions (Safford et al., 1990).

Bigleaf maple can live for approximately 200 yr. Early growth rate is high and can reach up to 1 m (3.3 ft) yr⁻¹. Between 15 and 30 yr, the species maintains a height growth rate of 0.3–0.6 m (1–2 ft) yr⁻¹ and diameter expansion continues up to 40 yr of age. A bigleaf maple tree can produce up to 16 L sap d⁻¹, although productive trees typically yield an average of 2 to 4 L d⁻¹. Theoretically, a tree could yield approximately 60 L of sap during a harvest season (Backlund and Backlund, 2004). While bigleaf maple sap has an average sugar concentration of 1.75° Brix, ranging from 1.0 to 2.5°, its concentration is lower than sugar maple, which ranges between 2 to 4° (Brix, or degrees brix [symbol Bx°] is a measurement of the mass ratio of dissolved sucrose to water in a liquid. It is determined with a saccharimeter that measures specific gravity of a liquid or more easily with a refractometer.)

Bigleaf maple sugaring has been successful, and there is an emerging sap industry that produces syrup, wine, and other sap products. Bigleaf maple trees typically grow in smaller stands than the sugar maple, this in combination with a lower Brix makes traditional syrup production economically disadvantaged. For these reasons, the bigleaf maple syrup industry may not achieve the economies of scale to compete with sugar maple. There is potential, however, for other value-added sap and novelty syrup products that may be able to capture niche markets

and expand this industry in new ways that the sugar maple industry has not explored.

Birch

Birches are abundant across North America. There are over 10 species in North America that have a northern boreal range from Alaska and the Yukon, across to Newfoundland and south into the New England states, the Great Lake states, and the Rocky Mountains of Idaho (Dixon-Warren, 2007). Paper birch and Yukon birch (*Betula neoalaskana* Sarg.) have been tapped for syrup production and other sap products. Paper birch has a wide distribution across North America and has the greatest potential for forest farming.

The outer bark of paper birch was used extensively by First Nations groups to craft baskets and construct canoes. They made toboggans from the bark and various groups also used it to wrap food for storage, as roofing and siding on temporary shelters, and to make infant carriers, cradles and masks (Turner, 1998). Birch sap has been used for centuries as a medicine, tonic, and health drink, as well as for wine and syrup-making in many countries, including Japan, Korea, China, Finland, and Russia (Terazawa, 1995).

Paper birch is considered a relatively high-value timber resource. The wood is sought after for its smooth grain and texture, dimensional stability and suitability for turning. It is used to make veneer products, pulp, oriented strand board and other fiberboard products in British Columbia (Peterson et al., 1999). Similar to bigleaf maple, the value-added potential of non-timber forest products like birch syrup and other sap products, are increasingly recognized and promoted as compatible with timber harvesting.

Paper birch sap has an average sugar content of approximately 1.0° Brix, and can vary from 0.5 to 1.5°. In comparison, the sugar content of the eastern sugar maple ranges from 2 to 4° Brix (Helfferich, 2004; Peterson et al., 1999). Birch may not be able to compete directly with sugar maple as a commodity; however, specialty birch sap products are capturing niche markets and have growing interests as a forest farming alternative.

Medicinal Forest Products

For as long as people have wandered the forests, they have gathered and made medicines from plants. Over time, people began cultivating herbs, most notably ginseng. By the early 1990s commercial production of ginseng under artificial shade was big business in many places, including Wisconsin, Ontario, and British Columbia. Cultivating herbs in the forest, however, was

done on a relatively small scale by a few growers scattered across North America. This has changed dramatically in the past 15 yr. There are now many commercial plantings of a wide variety of medicinal herbs in the forests. Individual plantings range in size from a few hundred square meters to more than 20 ha (50 acres).

An examination of the history of growing medicinal plants in forests is important to better understand the potential of forest farming in North America. In the early 1700s in Canada and in the mid-1800s in the United States, there were “ginseng gold rushes,” during which tens of thousands of kilograms of wild American ginseng (*Panax quinquefolius* L.) were harvested from the forests for export to China. It wasn't long before the wild populations were severely depleted by overharvesting, and people began experimenting with cultivating the plant. The first attempts at farming ginseng in North America failed miserably, but in the 1870s, Abraham Whisman of Virginia learned to successfully cultivate it. About that same time, George Stanton in New York started growing it in large quantities under wood lath shade structures. He is generally recognized as the first commercial ginseng grower in America. Prices paid for cultivated ginseng at that time were high and soon “garden culture” of ginseng became popular enough that the USDA published their first ginseng production publication in 1895. In 1905, Cornell University released a bulletin on diseases of ginseng (Van Hook, 1904). It documents several diseases and pests of cultivated ginseng and contains excellent photographs of infected plants, illustrations of the plant cells and infecting organisms, and descriptions of studies conducted to identify some of the disease-causing organisms. Unfortunately, *Alternaria* blight soon became a serious problem in many commercial ginseng gardens, and with no means to effectively control the disease, the industry dwindled to about 9.3 ha (23 acres) by 1909. The discovery that Bordeaux mixture, a copper fungicide developed in France, worked to control *Alternaria* on ginseng, caused an upsurge in production again. By 1929, there were approximately 175.5 ha (434 acres) of ginseng under cultivation in the United States.

After World War II, there was a slow increase in ginseng farming in the United States, with the bulk of the acreage being in Wisconsin. According to Persons and Davis (2005), U.S. production in 1996, with more than 1043,262 kg (2.3 million lb) of dried root produced (997,903 kg [2.2 million lb] of that being field grown). This coincided with a significant increase in production of American

ginseng in China and Canada. As expected, this resulted in an oversupply and fall in prices.

In Canada, Clarence Hellyer successfully grew ginseng in 1896 under a wood lath structure in Waterford, southern Ontario. His sons, Audrey and Russell, formed Hellyer Brothers in 1918 and grew ginseng commercially until 1970 (Persons and Davis, 2005). In 1962, there were only eight ginseng farms in Ontario, but by 1983 this number grew to about 60 farms. In British Columbia, there is anecdotal but unsubstantiated evidence of a few small plantings in the 1920s and 30s (BCMAFF, 2003a). The first commercial planting in British Columbia occurred in 1982. By the middle of the 1990s, there were about 2041 ha (4500 acres) of ginseng under cultivation in Ontario and almost 1361 ha (3000 acres) in British Columbia (BCMAFF, 2003a). All of this production was under artificial shade. Similar to the earlier ginseng gold rushes in both countries, the boom was followed by bust. Supply grew more rapidly than demand and prices fell. By 2003, the area under cultivation in British Columbia had declined to about 688 ha (1700 acres) (BCMAFF, 2003a) representing 162 harvested hectares (400 acres) and 590,000 kg (1.3 million lb) of root sold (BCMAFF, 2003b). The number of growers had declined from approximately 130 in the mid 1990s to 40 in 2003 (BCMAFF, 2003a).

The history of forest farming ginseng is a little harder to trace because no records were kept for sale of this type of ginseng. Forest grown ginseng roots were usually mixed in with wild roots and no distinction was made between the two. There is one paragraph devoted to "forest plantings" in the 1913 USDA Farmers' Bulletin (Van Fleet, 1913) on cultivation of ginseng. It states that the early successes with ginseng culture were made in the forest and that the method was still preferred by many growers at that time. The 1921 USDA Farmer's Bulletin (Stockberger, 1921) explained that forest plantings were less expensive to establish, but yielded about half as much as those under artificial shade. It also explained that growers on the Pacific coast could not grow ginseng in the woods. An interesting quote from that bulletin is: "There is always a ready sale for the cultivated roots which closely resemble the wild in quality and conditions, and prudent growers will not fail to adopt the wild root as the standard of future production." Growing ginseng in the forest produces "wilder looking" roots than growing in artificially shaded open fields. An early ginseng manual (Bryant, 1949) states, "Ginseng grown in the natural forest bed will command much greater, more attractive

prices than its cultivation under artificial shade." That manual strongly recommended growing ginseng in the natural forest. Yet, there was not widespread interest in growing ginseng in beds in the woods until the early 1990s. It was even more recently that growers seriously tried to produce the most natural looking ginseng by growing in the forest using a "wild-simulated" method.

Following the crash in the ginseng industry in the mid 1990s, many of the artificial shade growers who did not quit growing ginseng completely converted to forest farming. A survey conducted by Persons in 2000 indicated that there were more than 4000 U.S. growers producing ginseng in the woods, representing more than 809 ha (2000 acres) (Persons and Davis, 2005). In Quebec, there are an estimated 283 ha (700 acres) of ginseng in the woods (personal communication, ???YEAR???, Nadeau, Ginseng Boreal, Plessisville, Quebec, Canada). Market predictions indicate the demand for woods-cultivated and wild-simulated ginseng will continue to increase.

There are reports from the mid-1700s of European settlers in North America harvesting wild goldenseal (*Hydrastis canadensis* L.) from the forests. By 1860, the herb was in high demand, and by the 1880s there was already concern about the impact of overharvesting on native populations (Lloyd, 1912; Van Fleet, 1914). The USDA began experimenting with goldenseal cultivation under artificial shade in 1899 and published the first bulletin on it in 1905 (Henkel and Klugh, 1905). In the fall of 1903, the rising popularity of goldenseal as a medicinal tea pushed prices to \$2.20 kg⁻¹. This caught the interest of many ginseng farmers, who then began cultivating goldenseal. In contrast to ginseng, however, much of the early goldenseal cultivation appears to have taken place in the forest. The first large-scale commercial producer of goldenseal was the Skagit Valley Golden Seal Farm in Washington State in 1905 (Veninga and Zaricor, 1976).

An article on germinating goldenseal seed (Hus, 1907) explains that it was grown in gardens as an ornamental, and grown on a large scale for pharmaceutical purposes. The author's concern was that propagation of goldenseal was almost exclusively by division of rootstock, which was not a very efficient method. Seed propagation, however, was extremely difficult and few growers attempted it. Hus (1907) stated, "The importance of sowing fresh seed cannot be over emphasized; it is one of the essentials of success." Throughout his short article, Hus dispenses information that would benefit any modern day goldenseal grower.

A 1912 article by John Uri Lloyd is devoted to the cultivation of goldenseal. He describes experiments by Dr. H.T. Grime in Indiana from 1908 in which goldenseal was grown in gardens shaded by beans grown on poles, fruit trees, and grapevines and occasionally sprayed with Bordeaux mixture. He reported that the plants grew rapidly, had leaves 30 cm (12 inches) in diameter, and exhausted the soil, "worse than tobacco." The author concluded that goldenseal was easy to cultivate and the greatest threat to natural woodland cultivation would come from the poacher.

Goldenseal cultivation, under artificial shade and in the forest, rose and fell in step with supply and demand for the next few decades. Some farmers, including the Skagit Valley operation, experienced severe disease problems that caused them to cease production or move their operations completely. By 1960, the United States Department of Agriculture estimated that there were less than 2 ha (5 acres) of goldenseal under cultivation in the country. Veninga and Zaricor (1976) estimated that there were 40.5 ha (100 acres) or less in cultivation by the mid 1970s. In the early 1990s, demand for goldenseal rose once again. Pressure on wild populations was at dangerous levels, prompting action on the part of government and nonprofit agencies to protect the plant. United Plant Savers, a nonprofit organization dedicated to conservation of medicinal plants, with headquarters in Vermont, adopted goldenseal as its "poster plant" to encourage conservation and cultivation of wild medicinal plants. Growers across North America began producing the crop once again.

This latest increase in demand for goldenseal coincided with the drop in demand for ginseng. As a result, many ginseng growers in Wisconsin and Ontario began growing goldenseal. Much of the goldenseal was planted under the same shade structures the ginseng had been grown under. In other areas, forest production of goldenseal was more popular. According to the tonnage survey of the American Herbal Products Association (2007) (AHPA), in 1998 there were 42 ha (104 acres) of goldenseal cultivated under artificial shade and 14.6 ha (36 acres) in the woods. In 2004–2005, there were 25.5 ha (63 acres) under artificial shade and 22.6 ha (56 acres) in the woods. AHPA reported that in 1998, 117,409 kg (258,843 lb) of dried wild goldenseal root and rhizome were harvested compared with only 2923 kg (6445 lb) of cultivated material.

Small commercial gardens of ginseng and goldenseal are being planted on private forest land across North America. Growth in this

segment of the industry is driven by several factors. Many small landowners want to make extra income from their woodlands without cutting timber. There is a rising demand for domestically produced, high quality, forest-grown, certified organic material. There is more information and support for growers wishing to produce these crops. People enjoy the connection to their land and heritage, and the sense of sustainability that they get from growing their own native medicinal plants.

Current interest in growing forest botanicals is driven by a variety of forces. As the natural products industry grows, demand for raw materials increases. Recent food safety and quality issues with inexpensive foreign imports have convinced some companies to purchase more domestically produced herbs. Consumers are driving the demand for certified organic products. Concerns about the conservation of wild-harvested herbs are putting pressure on manufacturers to buy cultivated herbs. For many herbs, this has elevated the prices paid for cultivated material. At the same time, increasing numbers of forest landowners are looking for alternative crops, and since many of the herbs in demand are native to North American forests, growers often assume they should be easy to grow.

Marketing Medicinal Forest Products

Producing most of the popular herbs in a forest setting is not particularly difficult. The challenges are in the marketing and economics. The natural products industry deals with raw materials differently than the average agricultural commodity. For hundreds of years, the vast majority of the raw materials were obtained by harvesting from natural populations.

There are a plethora of manufacturers of herbal medicinal products, although there are relatively few companies who supply them raw materials. Most manufacturers do not purchase directly from the wild harvester or the farmer. They buy their raw materials from dealers who buy from farmers, small dealers, and wild harvesters. Novices or newcomers to this industry may be challenged to find buyers or to convince a buyer to purchase products from them. As with any commodity, relationships and trust must be built between the grower and the buyer.

New and interested growers need to learn all they can about the industry and how it works. They should inquire of the agencies (University extension services, state/provincial and federal departments of agriculture, and agricultural nonprofits) in their region and search the

internet for support programs. Interested growers should attend conferences, workshops, and at least one of the large natural products conventions that are held on the west and east coasts each year. Visiting other growers is an excellent way to learn about the industry. Whereas most farmers do not want to give away their secrets, most medicinal growers are proud of their successes and enjoy sharing what they are doing with other interested farmers. Offering to pay for consulting time makes the sharing of information a business transaction that most farmers are willing to engage in. There are many “tricks” to dealing with this industry that only experience, yours and theirs, will teach you.

Woodland Medicinal Plants

Ginseng is the major medicinal herb grown in the forest, in terms of hectares and quantities produced and sold. There are many excellent books and websites devoted to the commercial production of ginseng. There is also good information available on commercial cultivation of goldenseal. For other woodland plants, however, the information is limited. A general recommendation is to learn everything possible about the new plant and then start with the production practices recommended for ginseng and goldenseal and modify as necessary. With time and experience, production practices can be optimized for the new plant. Start small, keep careful notes, and expect to make many modifications along the way. A major raw material processor in North Carolina says it takes 7 yr for a farmer to master a new crop. The first few years are spent learning how to grow the plant and meet the buyers’ needs. A few more years are needed to acquire equipment and refine processes to increase efficiency and profitability.

Some forest botanicals are threatened, endangered, or of special concern. As such, they are protected by state, federal, and/or international laws. This includes ginseng and goldenseal. Check with local and federal departments of agriculture as to the status of the plant you want to grow. At the same time, interested growers need to be especially concerned about introducing non-native invasive species, as they can destroy plant populations and habitats.

For any crop, site evaluation is the first step. Most forest herbs grow well under 75 to 80% shade provided by a deciduous or mixed forest. Areas with deeply rooted hardwood trees such as beech, birch, maple, poplar, and basswood are preferred. Solid stands of conifers or other shallow rooted trees compete too much for water and nutrients. Most forest botanicals require a moist,

well-drained soil and will rot during a wet season if planted in an area where water stands. This is why many of these plants are found growing naturally on wooded slopes. Ginseng, for example, usually thrives on a north-or east-facing slope. Southern and western exposures are usually warmer and drier, and thus less favorable for it. Look for other woodland botanicals, or similar plants such as Solomon’s seal, growing in the area (Table 9–2). If there aren’t any, it might not be a good place to put your planting.

Many woodland botanicals tolerate a variety of soil types, although in general, heavy clays and very sandy soils should be avoided. An ideal soil is a loam with high organic matter. Collect soil samples from prospective sites and have them analyzed for nutritional status. Add soil amendments if necessary. Ginseng, for example, benefits from having the soil pH adjusted to about 5.5 and having phosphorus and calcium readily available. Depending on the soil types, this may require the addition of lime, phosphate, and/or gypsum.

There are basically two types of forest cultivation systems for herbs: woods-cultivated and wild-simulated. The objective of a wild-simulated production system is to mimic the way the plant would grow naturally. It is simple, inexpensive, and requires few inputs. Generally, the plants grow slower and yields are lower than in the other system, but since inputs are lower, profits may be similar or even higher. For ginseng, the roots produced in a wild-simulated system are more valuable than those produced in a woods-cultivated system. In a woods-cultivated system, the objective is to produce the highest yields feasible by growing intensively. All modern production practices and pest control products are used.

For wild-simulated production, leaves are raked aside to expose the soil in the production area. Some growers sprinkle gypsum or lime on the soil and rake it into the top few centimeters of soil. Seed are scattered over the soil surface, or shallow trenches are dug to accommodate

Table 9–2. Herbaceous plants and trees that live in association and share the same habitat.

Understory herbs	Overstory tree species
Ginseng	Sugar maple
Black cohosh	American beech
Bloodroot	Red oak
Mayapple	Yellow birch
Trillium	Silver maple
Jack-in-the-pulpit	American basswood
Wild ginger	Black walnut
Trout lily	Butternut
Wild geranium	Hackberry
Hepatica	Red and black ash

rootstock. Both are planted thinly so each plant will have plenty of room to grow and not compete with each other. The seeds or rootstock are covered with soil, and the leaves are redistributed over the planted area. Then the plants are allowed to grow naturally. Most growers do not spray fungicides or add any additional fertilizer. Most will try to pull big weeds and control any animals that may feed on the plants.

For the woods-cultivated system, all obstructions such as stumps, rocks, and big roots are removed. The soil is tilled, and soil amendments such as lime and phosphate are incorporated. Raised beds are often built to improve soil drainage. Seed or root stock is planted more densely than in the wild-simulated system. A thick layer of mulch is added, usually straw, but in some areas composted sawdust or hardwood bark is used. The plants are monitored closely and may be fertilized and sprayed with fungicides or insecticides on a regular basis. Weed and animal control are practiced.

The root is the plant part of economic value for most forest botanicals. Depending on the species, plants grow from 3 to 8 yr before the roots are large enough to harvest. During this time, seed and sometimes foliage can be harvested. Seeds of forest botanicals usually have unusual requirements that must be met for them to germinate. For example, ginseng, goldenseal, and bloodroot seeds must never be allowed to dry out. Ginseng seed must be stratified for a year before sowing. In contrast, goldenseal seed usually exhibits the best germination if the fresh seed are sown.

When roots are large enough for harvest, they must be carefully dug to minimize injury. In a wild-simulated system, this is done manually with spades or forks. In a woods-cultivated system, this process may be partially mechanized by using a tool, similar to a potato digger, to bring the roots to the surface for collection. Roots must be washed, and then for most markets, dried. The washing and drying process must be done properly to maintain quality and should be practiced before the main crop is harvested. Practice sessions can create samples to be sent to prospective buyers for evaluation or testing for heavy metals, pesticides, bioactive constituents, and microbial contamination. Dried roots and herbs must be carefully packed into the kind of containers specified by the buyer. These are usually cardboard barrels or poly sacks. Store packaged herbs in a cool, dry atmosphere and protect from rodents and insects.

Farming the Forest for Oregon-Grape

Oregon-grape is the common name for a number of species in the genus *Mahonia* found in western North America ranging from British Columbia down to California and eastwards, depending on the species. The commonly recognized Oregon-grape species of the Pacific Northwest are dull Oregon-grape (*Mahonia nervosa* Pursh.), creeping Oregon-grape (*Mahonia repens* Lindl.), and tall Oregon-grape (*Mahonia aquifolium* Pursh.). The different species vary by height and leaf structures, although the leaves of all resemble holly. All grow from underground rhizomes; the inner bark of stems and rhizomes is bright yellow due to the presence of an alkaloid, berberine, which has medicinal applications. The berries of Oregon-grape are dark blue with a whitish bloom, and edible, though tart. The bark of the stems and rhizomes can be used for making a yellow dye, and was used by First Nations to color basket materials or porcupine quills.

Oregon-grape is used commercially as a medicinal herb, a landscaping plant, as a floral green, and in small-scale processed food products (mainly as a jelly). In British Columbia in the late 1990s, Oregon-grape was second in value only to St. John's-wort in terms of value as a wild-harvested medicinal herb (Small Woodlands Program of British Columbia, 2001). All three species listed above are medicinally active and used interchangeably in medicinal preparations, although *M. aquifolium* Pursh. is the official medicinal herb (Howe, 2006AUTHOR: NO MATCHING ITEM IN REF LIST; PLEASE ADVISE). Oregon-grape (especially *M. aquifolium* Pursh.) is in demand for the landscaping and reclamation markets, with its attractive evergreen foliage, bright yellow flowers, edible berries that attract wildlife, and good drought tolerance. Oregon-grape also has some limited market as a floral green for use in flower arrangements. A tasty jelly can be made from the fruits either on their own or in combination with other berries (i.e., salal).

Other than plants being produced for the landscaping/reclamation trade, material for other commercial purposes—including the medicinal herb market—appears to originate from wild resources. Oregon-grape grows best on well-drained (often quite rocky), acid soil, but will tolerate a wide range of growing conditions. It is shade tolerant, although it may grow spindly under shade. Oregon-grape has a moderate growth rate and spreads by underground rhizomes; it can also be propagated by seeds or cuttings. In agroforestry applications, Oregon-

grape appears best-suited to production under forest farming systems (Small Woodlands Program of British Columbia, 2001).

Oregon-grape can be harvested at any time of year for the medicinal market, but alkaloid levels may be higher in the late summer or fall. Rhizomes should be hand dug using a fork; pull until the rhizome stops lifting, then cut or clip it off. It may be possible to include the lower stem, below the lowest leaves, in marketed material but it is advisable to check with the buyer first. The soft outer bark is easily removed and care must be taken that it is not stripped off during harvesting because roots and rhizomes without root bark are unacceptable to buyers. Mechanical harvesting destroys other plants in the area, leads to soil compaction, and damages the root bark, resulting in an inferior product. The rhizome/roots left behind should be able to regenerate new plants. Wash the material carefully to avoid removing the bark. Roots and rhizomes should be cut before drying unless access to commercial cutting machinery is available, as the roots become very hard and difficult to process when they are dry.

Although locally abundant in many parts of its range, Oregon-grape is on the United Plant Savers "Plants to Watch" list. For wild harvesting, an assessment of local stocks and monitoring of regeneration rates for the site should be part of any harvesting plan. Oregon-grape is frequently cited as a substitute for goldenseal and is therefore being harvested more heavily than in the past due to the endangered status of wild goldenseal stocks (Howe, 2006AUTHOR; NO MATCHING ITFM IN REF LIST; PLEASE ADVISE).

A Community Group Farms the Forest for Hawthorne

The West Kootenay Herb Growers Cooperative (Edgewood, British Columbia) grew out of a rural economic development initiative, in a community keenly interested in countering population loss and a shrinking economy. The sentiments for the creation of the Cooperative are captured in the words of an unknown member:

None of us really have any background on medicinal herbs. Many of us have small cattle/ranch operations, subsistence farming, have tried things like mushrooms, etc. What we share is a common interest and strong motivation in this area as well as [in] the environmental aspects.

The main purpose of the Cooperative is to develop herbal specialty crop opportunities, which balance economic, social, and ecological concerns, focusing on agroforestry production practices. The integrated nature of agroforestry systems reflects identified community (social)

enterprise needs of economic feasibility coupled with environmental sustainability.

With this in mind, one of the initial goals of the Cooperative was to determine the economic viability of native hawthorn as a medicinal herb crop. In addition to the reported health benefits and established markets for the standard medicinal species, hawthorn was chosen based on local abundance, community familiarity, and personal use experience (jams, jellies, tinctures). These attributes were coupled with the potential for plant usage in riparian restoration, mitigation of soil erosion, and enhancement of fish and wildlife habitat.

Hawthorn (*Crataegus* spp.) is a member of the *Rosacea* family, with 208 species and 215 taxa (USDA, 2007). Species used in medicinal preparations include *C. laevigata* Poir., *C. oxyacantha* L., *C. monogyna* Jacq., and occasionally *C. pentagyna* Waldst. and Kit. ex Willd (Nemecz, 1999). Some sources indicate *C. oxyacantha* L. is synonymous with *C. monogyna* Jacq., though misapplied (USDA, 2007). The American Herbal Pharmacopoeia (Upton, 1999a, 1999b) states that *C. oxyacantha* L. is synonymous with *C. laevigata* Poir. as well. The species, native to British Columbia, have been reported to possess "medicinal value" and are referenced in the American Herbal Pharmacopoeia, but neither has been studied extensively. There is little in the way of detailed studies that provide sufficient evidence to health product manufacturers and distributors that native hawthorn species may be comparable to those used for medicinal preparations. There is a scarcity of information regarding crop management practices and basic processing techniques, such as optimal drying conditions.

Translating social, economic, and ecological goals into practice has not been a simple process. There is a need to test and demonstrate that *C. douglasii* Lindl. and/or *C. columbiana* Howell are equivalent to or of higher standard than the medicinal species. In turn, results of the research have to be communicated to regulatory agencies, researchers, labs, manufacturers, etc. Thus, the Cooperative is comparing four species (*C. douglasii* Howell., *C. columbiana* Howell., *C. monogyna* Jacq., and *C. laevigata* Poir.), in a trial at a common location. Additionally, they are looking at differences due to geographic and genetic variations in plant and chemical characteristics. At every stage of the process, samples of the flower, leaf, berry, and branch are sent to the lab for analysis. Additionally, pressings are also sent for DNA barcoding and species identification, as plant identity is one of the most critical issues

surrounding the purchase of raw materials by natural health product manufacturers. Plant species must be specified for product licensing. The major steps involved in the process are:

1. Botanical identification of the native hawthorn species.
2. Determination of the variation in bioactive characteristics due to intrinsic (e.g., genetic) and extrinsic (e.g., growing, harvesting, and processing conditions) effects.
3. Comparison and evaluation of results among the botanical species identified (presumably *C. douglasii* Lindl. and *C. columbiana* Howell.), introduced medicinal species growing on the same sites, medicinal standards, and variability imparted by specific growth habitats and management practices.
4. Development and documentation of detailed management and processing practices for hawthorn based on trial results.

From the marketing side, the Cooperative has found that manufacturers are very interested in the hawthorn project because it offers them the potential for access to a new pedigree, high-quality product. From harvest to processing, good agricultural practices are critical. All raw materials are tested for biological and chemical contaminants. Processing, storage, and handling have a significant influence on product quality, and quality is of paramount importance to natural health product manufacturers when sourcing raw plant material. The Cooperative will have developed a set of management practices based on science and research, which will ultimately lead to a higher quality product that meets the manufacturers' needs. Based on their recent communications with a natural health product manufacturer, this will provide the necessary access to the marketplace and the opportunity to sell their product at a premium.

Plants Commercially Forest Farmed

This chapter is devoted to cultivation of plants in forest farming systems and is intended to provide alternatives of interest. The examples above illustrate how specific species can be farmed in the forest. There are many other species that are either commercially farmed, or have potential to be forest farmed. Most of the herbs described have many traditional and modern uses. Only a few uses are mentioned to give the reader a sense of the plant's use. There is an established market for the following herbs, and some commercial forest production is underway in North America. Readers interested in pursuing these alternatives are encouraged to do more research

and to learn as much as possible about the plant and its production and markets. The information contained here is derived from Cech (2002) and Persons and Davis (2005).

Black Cohosh (*Actaea racemosa* L.). This is a very popular woman's herb used for the treatment of menopausal symptoms. The popularity of this herb has caused concern for the species well-being, and cultivation is strongly encouraged. Fortunately, it is easy to grow. It is an attractive shrub, which can get quite tall, with delicate, lacy-type foliage. It thrives in rich, moist soil. The roots are harvested in early fall for medicinal use. It can be propagated by dividing the rootstock in the spring or fall. Seed propagation can be difficult. Demand for cultivated material is increasing.

False Unicorn (*Chamaelirium luteum* L.). Also known as star root, devil's bit, and fairy wand, false unicorn is a rather unobtrusive plant that starts out as a very low rosette of leaves. It has separate male and female plants, which send up very tall flower stalks. The plant is slow to grow, and mortality can be high in some years. False unicorn can be grown from seed or rootstock cuttings. It is considered an important woman's herb but also is used to treat a wide range of disorders such as pain, poor appetite, and cough.

Ginkgo (*Ginkgo biloba* L.). This an ancient tree that is used extensively as an ornamental in cities across North America. The leaves are harvested and used to enhance memory and treat circulatory problems. Ginkgo is usually grown in a monoculture system, and there are several very large plantations in the United States (observations by the authors). Growing it in a forest of mixed species is rare.

Ginseng. With its long history of cultivation in North America, information on how to grow ginseng is readily available. It is, however, probably the most difficult to grow of all the herbs listed here. It is prone to disease and takes a very long time to reach harvestable size. If you live in an area where people harvest wild ginseng, your ginseng is also at risk from poaching. Ginseng is propagated by seed, and by transplanting 1- or 2-yr-old roots. Ginseng is used as a general tonic, to improve fertility, reduce stress, and to treat certain diseases.

Goldenseal. Goldenseal is used for many purposes, including as a treatment for AIDS, cancer, various digestive disorders, and to boost the immune system. It once grew abundantly in

forests across eastern North America. Native populations have been seriously reduced by over-collection, and it is now an endangered species in some states and regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Goldenseal is propagated by divisions and seeds.

Skullcap (*Scutellaria lateriflora* L.). This low growing perennial grows in open woods and on the edge of woods. The roots are harvested in the fall and used as a laxative and to treat respiratory and uterine problems. Skullcap is grown commercially in some areas in the woods and open fields.

Slippery Elm (*Ulmus rubra* Muhl.). A tall tree that grows in the woods throughout eastern North America, the inner bark of slippery elm is harvested in the spring and fall. It is used as a laxative and to treat skin conditions, sore throats, stomach ulcers, and wounds. Cultivation is steadily increasing.

Wild Yam (*Dioscorea villosa* L.). Wild yam is a perennial vine that grows in forests and on the forest edge in the eastern United States. Roots are harvested in the fall and used to treat menopausal symptoms, asthma, and gastrointestinal problems. The amount of cultivated wild yam is small but increasing.

Plants with Potential for Forest Farming

These are traditionally wild-harvested herbs that have been traded for generations. Some have very limited markets and there are only a few known growers. Little is known about these plants and their production methods. Pursuing these alternatives may be more challenging, but also may be more rewarding.

Bethroot (*Trillium erectum* L.). Bethroot grows to about 0.5 m in height and has a single brown or greenish-purple flower. The roots of this plant are harvested in the fall and used to treat hemorrhages, skin infections, and heart palpitations, among other disorders. This plant is challenging to cultivate and there is no forest-farmed material on the market.

Black Root (*Veronicastrum virginicum* L.). Also known as Culver's root, black root is a tall perennial that grows in moist forests throughout North America. The dried root is used as a mild laxative. The fresh root is toxic.

Bloodroot (*Sanguinaria canadensis* L.). An attractive, low-growing plant with pretty white

flowers in very early spring, bloodroot can often be found growing in deep woods. It spreads naturally by rhizomes and seeds and can be easily propagated by both. The root has a long history of use by Native Americans and has proven antimicrobial activities. It can be toxic, however, and should not be used casually. In the past decade, bloodroot was used in a toothpaste and livestock feed.

Blue Cohosh (*Caulophyllum thalictroides* L.). Another beautiful plant that is commonly found in hardwood forests in southern Appalachia, blue cohosh plant grows to about 1 m in height and can have very blue foliage. The rhizomes can be divided in spring or fall. Seeds are difficult and slow to germinate. Blue cohosh is another woman's herb, traditionally used to aid in childbirth.

Boneset (*Eupatorium perfoliatum* L.). Boneset is a shrub that grows in woods throughout eastern North America. The top of the plant is harvested and dried and used as a laxative and to treat coughs, fevers, and chest illnesses. Boneset is grown in a wild-simulated system by a few growers, particularly in the southeastern United States.

Lady's Slipper (*Cypripedium* spp.). Lady's slipper is a highly desirable ornamental and medicinal plant, of which many species grow across North America. Most buyers stopped buying lady's slippers because wild populations were being so heavily damaged. Some cultivated material is now on the market, and small amounts are again in trade. Lady's slippers have distinctive "pouch-like" flowers of a variety of colors. They prefer rich woods and wet areas. Some of the species are very difficult to propagate. The roots are used as a mild sedative, to treat headaches and depression, and for menstrual difficulties.

Mayapple (*Podophyllum peltatum* L.). Mayapple grows on the edge of the woods. It emerges in early spring and produces a tall plant (0.3–0.61 m [1–2 ft]) with an umbrella-like leaf. It is easy to propagate by dividing the rhizomes. There is interest in its use for treatment of cancer, liver problems, and constipation.

Maypop (*Passiflora incarnata* L.). Also known as passionflower, maypop is a perennial vine that grows on the forest edge and in open woods, mostly in the eastern United States. The top of the plant, with flowers and fruit, is harvested in the summer. It is used as a mild sedative and to

treat skin problems. Maypop is produced on a small scale by at least a few farmers.

Oregon-Grape (*Mahonia* spp.). An evergreen perennial shrub, there are different species of oregon-grape that grow throughout North America. The roots contain berberine and are sometimes used as a goldenseal substitute. It has antimicrobial properties and is a liver stimulant.

Partridge Berry (*Mitchella repens* L.). Also known as squaw vine and squaw berry, partridge berry is a low-growing perennial vine found in the east. The top of the plant is harvested in the fall and used to treat diarrhea, as a diuretic, and to aid in childbirth. There are some small-scale producers of the plant.

Pinkroot (*Spigelia marilandica* L.). Referred to as Carolina pinkroot and Indian pink, pinkroot is a beautiful plant with elongated flowers that are red on the outside and yellow on the inside. It is easy to propagate by root divisions. It is commonly used to aid digestion.

Spikenard (*Aralia racemosa* L.). Spikenard grows 0.3 to 3 m (1–10 ft) tall and bears elongated flower stalks covered with yellow-green flowers that develop into purple berries. It grows in rich woods and on riverbanks. Spikenard is easy to cultivate and can be propagated by division. The roots are harvested in the fall and used to treat many ailments, including backaches.

Stargrass (*Aletris farinosa* L.). Also known as true unicorn root, devil's bit, and blazing star, stargrass is a perennial that grows in moist woods and meadows. The roots are harvested in the fall. It is used as a sedative and tonic. There is little trade of cultivated or wild-harvested material at this time.

Stone Root (*Collinsonia Canadensis* L.). Stone root is a perennial that grows in moist woods. The roots are harvested in the fall and used as a sedative and tonic. It is known to be grown on a very small scale by a few growers.

Virginia Snakeroot (*Aristolochia serpentaria* L.). This perennial grows in moist woods in the east. Roots are harvested in the fall and used to treat wounds and skin ulcers.

Yellow Indigo (*Baptisia tinctoria* L.). Also known as wild indigo, yellow indigo grows to about 1.2 m (4 ft) in height and has small leaves and a large number of small yellow flowers. It prefers a little more light and a drier soil than the other plants discussed here. Propagate by cuttings or seed. It

has a long history of use for treatment of sore throats, typhus, wounds, and to enhance the immune system.

Yellow Root (*Xanthorhiza simplicissima* Marsh.). A common shrub that is often found growing in damp woods and on stream banks in the mountains, it has a bright yellow root that is used as a tonic and to treat many of the disorders for which goldenseal is used. It is propagated by division.

Wild Ginger (*Asarum canadense* L.). Wild ginger is a low-growing plant with heart shaped leaves and brown bell-like flowers. It grows in cool, shaded, moist woods and is propagated by root division. It is used to treat intestinal gas, motion sickness, and as a stimulant.

Many other forest medicinals are wild-harvested and could be cultivated. Growers interested in pursuing these potential opportunities should check market demand and prices before attempting to grow these plants on a large scale. A great deal of time, energy, patience, and persistence is needed to realize the full benefits of forest farming woodland medicinal forest plants.

Floral/Decorative Forest Products

Creative and entrepreneurial landowners can farm their forests for plants used in production of decorative products or landscaping. Many forest plants and parts of plants are used in arrangements, to complement and furnish the backdrop for flowers, as well as for the main component of dried ornaments. The end uses for many floral greens include fresh/dried flowers, aromatic oils, greenery, basket filler, wreaths, and roping. Floral products from oak ecosystems of southern Appalachia include various species of grapevine (*Vitis* spp.), kudzu (*Pueraria lobata* Willd.), smokevine (*Aristolochia macrophylla* Lam.) for wreaths and baskets; galax (*Galax urceolata* Poir.) for floral decorations; and twigs from several tree species. Several genera of moss are harvested from forests and used domestically or exported to the European floral industry. These and others can be farmed from the forests by private landowners.

Decorative Products

An array of plant species can be forest farmed for the decorative market. Baskets made from branches, needles, and wood splits have ready markets. The tips of pruned evergreen trees can be fashioned into wreaths, roping, and garlands. Also Christmas trees, from native or exotic evergreens, are a well-established segment of the

decorative market. In Vancouver British Columbia, the United Flower Growers Cooperative has recorded commercial sales of more than 60 wild-harvested forest species. Some of the top selling products include: beargrass, pussy willow, boxwood, moss, rose hips, huckleberry, horsetail, ferns, dogwood, and scotch broom (Cocksedge and Hobby, 2006). AUTHOR: LATIN BINOMIALS AND AUTHORITIES?

Native-stand Christmas trees and Christmas tree farms produce important and lucrative seasonal crops. Evergreen species generally grown or managed for Christmas trees include true firs (*Abies* spp.), pines (*Pinus* spp.), and eastern red cedar (*Juniperus virginiana* L.). Other species that may be grown in certain areas of the United States and Canada include spruces (*Picea* spp.), Douglas-fir (*Pseudotsuga menziesii* Mirbel.), Leyland cypress [*Cuprocyparis leylandii* (A.B. Jacks. & Dallim.) Farjon], and Arizona cypress (*Cupressus arizonica* Greene.). The appearance and health of a tree is very important. Trees should have ample amounts of rich, dark foliage; have a straight trunk; retain needles for a long time after being cut; have branches thick and durable enough to support ornaments; have a symmetrical, dense, conical form; and a pleasant aroma. Trees are generally harvested when they are 2.1 m (5–7 ft) tall. Larger trees, however, may be targeted for specialty markets. Landowners may harvest trees to sell at retail lots, or allow customers to cut their own tree on the property (a “choose-and-cut” or “U-cut” operation). In a choose-and-cut operation, trees that are ready to be harvested should be well-marked. Landowners may cut trees that customers choose or provide saws and sleds for customers to cut and transport trees.

Pruning and shearing trees is essential to produce superior and premium trees. Evergreen boughs or tips used for wreaths, roping, sprays, swags, centerpiece displays, and garlands are particularly popular in the winter months during holidays. Using the prunings or “waste” materials from harvest in wreaths and other seasonal pieces is one way of value-adding in a Christmas tree business. Boughs commonly used for wreaths in various parts of North America include pines (*Pinus* spp.), hollies (*Ilex* spp.), junipers (*Juniperus* spp.), firs (*Abies* spp.), spruce (*Picea* spp.), western red cedar (*Thuja plicata* Donn.), Douglas-fir (*Pseudotsuga menziesii* Mirbel.), and yellow cedar (*Chamaecyparis nootkatensis* D. Don). Deciduous plants also are used for wreaths and include willows (*Salix* spp.), ivy (various species), grapevines, kudzu, and

smokevine. Mistletoe, the parasitic plant, is collected and used for decorations. Vines or twigs are harvested in the fall and winter when plants are dormant, and evergreens are harvested from October through December. Wreaths are usually 30.5 to 121.9 cm (12–48 in) in diameter, and roping is produced in lengths of 2.4 to 23 m (8–75 feet) and sold in rolls. Some plant parts, such as cones or dried fruit, and branches from deciduous shrubs also may be valuable additions to wreaths and roping.

Harvesting pine tips (“tipping”) for holiday greenery may bring added income while the trees are maturing. Tipping is done after the fall needle drop ends, from October through December, on trees that are more than 7 yr old. Tips 20.3 to 45.7 cm (8–18 in) long are harvested with pruning shears or a sharp knife from the lower whorls of branches, leaving the terminal growing tip for future growth. No more than half of the tips should be removed in one season. Tipping can be repeated two or three times in a 4-yr period without harming the tree. Tips should be sold as soon as they are harvested, or stored in a cool, dry area if necessary.

In a forest farming system it may be necessary or desirable to thin trees to decrease shade or increase spacing. The thinned materials should not be considered waste, but may present opportunities for added income. The wood may be used for a variety of decorative products. Interesting features that vary the form, color, or grain of wood increase the value. Some of these valuable features include burls, which form when an injury causes a deformity such as swirled, marbled, wavy, spotted, or otherwise unique growth patterns; crotch wood which has a flamed or feathered grain pattern; spalted wood, where hardwood trees begin to decompose and are attacked by bacteria which create ‘ink lines’ with an interesting appearance; natural variations in grain such as “curly” or “bird’s-eye” patterns; knees found on cypress (*Toxodium* spp.) trees; or knots found in various species. Unique pieces typically are sold directly to crafters, wood turners, hardwood retail outlets, or specialty wood dealers.

Understory forest trees and plants can be nurtured and harvested to produce useful products. Baskets are made from thin, flexible stems, needles, or “splints.” Splints are made by splitting logs from the top to the base into quarters with a maul or wedge. A knife is then used to split the wood parallel to the growth rings. Splints are then shaved or trimmed until they are thin and smooth. Plant species that are popular for baskets include willow (*Salix* spp.) branches,

blackberry or raspberry (*Rubus* spp.) canes, pine (*Pinus* spp.) needles, oak (*Quercus* spp.) splints, hickory (*Carya* spp.), maple (*Acer* spp.), ash (*Fraxinus* spp.), or poplar (*Populus* spp.). Kudzu (*Pueraria lobata* Willd.) also can be used to make baskets. Finished splints, needles, or stems are soaked in warm water to make them flexible for weaving. A variety of designs and techniques can be used to create baskets.

Landscaping Plants

Many native plants are valued for landscaping and could be farmed in a forest setting. Trees, shrubs, and perennials are commonly planted around homes, offices, stores, and streets for both beauty and function. Well-planned landscaping can increase the economic value, visual appeal, and usage of a site. Landowners can supplement their income by forest farming desirable plants to sell as transplants to nurseries, landscape businesses, or homeowners.

A landowner interested in supplying the landscape industry can grow desired plants under the forest canopy. As transplanting causes stress that may weaken or kill the plant, only strong thriving plants that are free from pests and disease should be harvested. Transplanting is best done in late fall and early spring while plants are dormant and the soil is not frozen. The less the root system is disturbed, the better chance a plant has of surviving. After digging, transplants should be watered and placed in an area that is protected from wind and direct sunlight until the landowner is ready to plant or sell them.

Herbaceous perennials may be dug and transferred to a pot for transport. Use a spade or garden fork to gently loosen the soil around the roots. Pulling a plant by the stem or crown can cause damage; the plant should be lifted by supporting the roots instead. Extra soil may be needed to fill in around the roots to stabilize the transplant in the pot.

Larger trees and shrubs will need to be balled and wrapped in burlap. Since most of the active water- and nutrient-absorbing roots are at the periphery of the root system, it is necessary to prune the roots to encourage rooting closer to the trunk. New roots will form at the cut edge, inside the area that will be balled. Three to 6 mo before transplanting, use a spade to prune roots 10.2 to 15.2 cm (4–6 in) inside the area that is to be dug. To determine the ball size, add 30.1 cm (12 in) for each inch of trunk diameter measured at 15.2 cm (6 in) above the soil line. If the trunk is 5 cm (2 in) in diameter, the ball size would be 61 cm (24 in). During the next dormant season but no more than 2 yr later, the root ball is dug by

hand or by machine. Scrape the top of the soil to remove weeds and grass. If the ball is dug by hand, dig a trench outside the area to be balled. Continue digging down for half of the ball size, and then start to carve out the bottom of the root ball. The soil in the root ball should be disturbed as little as possible to keep the ball firm and well-packed. After the root ball is finished, the tree is placed onto burlap (or the burlap is slid under the tree if the root ball is loose), wrapped, and secured with string or special pinning nails.

Salal: The Ubiquitous Floral Green

Salal (*Gaultheria shallon* Pursh.) is among British Columbia's most important commercial non-timber forest products. An evergreen perennial native to the Pacific Northwest, salal is one of the most common shrubs in Coastal British Columbia. It is found along the coastal regions from southern California to northern British Columbia in coniferous forests at low to medium elevations (Pojar and MacKinnon, 1994). Regarded as a nuisance by many forest workers, salal is highly sought after by the floral industry for its leathery, long-lasting, glossy dark green leaves (Cocksedge, 2003). The species presents a viable opportunity to develop extensive forest farming in much of British Columbia.

The annual harvest of salal is estimated to generate between Can\$27 million and Can\$45 million to the economy of British Columbia. Export and domestic sales have steadily grown in the last decade. South Vancouver Island is estimated to contribute 25 to 30% of the annual harvest. The general trend from 1995 to 2005 indicated a steady increase in exports, although the salal market has been changing in recent years. Exports to Europe declined markedly in 2004. The rising Canadian dollar has been a factor in the softening salal market as the product has become more expensive for European buyers and substitutes may be decreasing demand. In addition, consumer interests have been changing and may account for some of the decrease in demand. Interest has shifted from pre-made designed floral bouquets, in which salal is background filler, to a "do-it-yourself" market where consumers purchase flowers and create their own bouquets. Overharvesting may be affecting product quality, with an associated decline of more desirable long stems (Cocksedge and Hobby, 2006).

According to Hobby et al. (2006), the 1.5 million hectares covered by the South Vancouver Island Forest District includes an estimated 650,000 ha of suitable salal habitat. Much of this forest district is, uncharacteristically, in private ownership,

which presents opportunities for forest farming of this valuable non-timber forest product.

There is a large and diverse labor force from which to build forest farming with salal. The majority of the estimated 15,000 people in British Columbia who participate in the salal harvest are of first generation Asian descent, including Vietnamese, Laotian, Korean, and Cambodian, among others. A survey of harvesters on central Vancouver Island (Hobby et al., 2006) found that they earn an average of Can\$150 d⁻¹, with an estimated average full-time income of about Can\$30,000, working over a nine- or 10-mo period. The gender ratio of typical harvesters of the region is 40% female to 60% male. Many harvesters work as couples and as small groups that share transportation. Almost three-quarters of the harvesters are estimated to be 30 to 50 yr old. More than 80% also harvest other non-timber forest products, such as cedar and pine boughs, berries, and morels. In addition, some harvesters are employed in other industries, such as oyster and shellfish farms.

The salal industry, which has developed over more than 50 yr, has a strong international market. One factor that accounts for the successful commercialization of salal is its long shelf life, which lowers the risk of product spoilage. The extensive road network in prime harvesting areas (public roads and particularly logging roads) provides excellent access. Prices and markets have been stable, leading to predictable market conditions.

Conditions may be changing for the continued unmanaged harvest that may enhance opportunities for forest farming. Harvesters and buyers have expressed concern that human impacts (e.g., overharvesting, poor harvesting techniques, and logging) are reducing the abundance of the salal resource. The lack of land tenure, which allows for transients who don't take the time to harvest properly to "raid" locals patches, puts excessive pressure on the resource. The harvest of timber and the lack of silvicultural treatments that take into account the light requirements of salal result in significant increases in sunlight, which decreases the quality of the floral greens. Closures of logging roads have also limited access to many harvesting areas, potentially increasing pressure on the remaining accessible areas. Some private landowners in Washington state and British Columbia are responding to these factors by selling permits to salal buyers for exclusive rights to manage the harvest. This may lead to more integration of salal forest farming with timber production in the region.

The salal industry on Vancouver Island displays many characteristics of the wider non-timber forest products sector in British Columbia. Salal generally is not included in forest planning, management, and practices. Also, salal harvesting is characteristic of the sector in that it is neither recognized nor structured as an organized business sector. There is neither a salal trade association in British Columbia, nor any sector-wide or product-specific association to represent the industry in policy debates about forest management or the future of rural communities.

Pine Straw

Managing pine forests for the harvest of the needles, also known as *pine straw*, offers an interim income stream while timber or pulpwood stands are maturing. Pine straw makes attractive landscape mulch and protects the roots of plants from extreme temperatures, supplies nutrients upon decomposition, and reduces weed growth, erosion, and evaporation of water from the soil. The low pH of the resin on the needles creates a preferred environment for acid-loving landscape plants such as azalea (*Rhododendron* spp.), rhododendron (*Rhododendron* spp.), camellia (*Camellia* spp.), gardenia (*Gardenia jasminoides* Ellis), and blueberries (*Vaccinium* spp.). With this in mind, it may be possible to farm the forest for multiple crops—pine straw and live plants for landscaping. Compared with other mulches, pine straw may last longer and cover more area per cost of materials. It has become a preferred mulch throughout much of North America. Pine straw is flammable and should be integrated into homeowner fire plans.

A good site to establish a pine straw operation should be relatively flat with minimal soil erosion potential. The species that produce the most desirable straw are longleaf (*Pinus palustris* P. Mill.) and slash (*Pinus elliottii* Engelm.) pine. Loblolly pine (*Pinus taeda* L.) also may be used, but the needles are shorter and more difficult to bale. Stands with basal areas of 6.96 to 11.6 m² ha⁻¹ (75–125 ft² ac⁻¹) can produce approximately 125 to 175 bales raking⁻¹, respectively, each weighing about 13.6 kg (30 lb). Pine straw is the secondary crop to timber, and spacing should be determined by the primary objective of growing wood. The first harvest can begin as early as 8 to 12 yr in plantations, later in natural stands.

Biomass Production

Most contemporary discussions of forest farming include only medicinal plants, other specialty crops and shade-tolerant plants, yet we consider

a broader range of opportunities for forest landowners to farm their lands. Biomass refers to renewable organic matter and includes trees and other plants, wood and wood waste, agricultural crops and residues, as well as municipal and industrial waste products. Biomass production requires using farming practices to produce forest crops and has great potential as an alternative income-generating source. As an associated practice, utilization of forest biomass for energy may offer benefits to private landowners, including improved management of forest resources, increased revenues, and fire and pest control.

Only a small portion of the total amount of woody biomass that is available for bioenergy is actually used for that purpose. Many forest stands have a large number of stems per hectare with stagnated growth that does not allow trees to attain marketable dimensions. Hardwoods in pine forests are a potential source for a tremendous amount of biomass for energy production. Harvesting biomass from smaller and less desirable trees can enhance the residual stand. Pre-commercial thinnings can provide financial returns if biomass energy markets exist. Biomass thinnings can remove undesirable trees and improve the growing conditions for the remaining trees.

Production of short-rotation woody crops, such as fast growing trees, grasses, and shrubs, can meet increasing fuel demands while providing environmental and economic benefits for private landowners. Short-rotation woody crops can be integrated as components of forest farming systems or grown in plantations. The availability of land with favorable climate, growing conditions, appropriate species, and an established transportation infrastructure are critical factors when considering development of biomass energy production facilities. Short-rotation woody crops harvested for biomass energy production have the potential to provide economic and environmental benefits to private landowners. They can reduce the overall contribution of fossil fuels to global warming, while meeting energy production needs.

In forest farming systems for short rotation woody crops, trees are managed intensively using farming practices that may include site preparation by plowing, disking, harrowing, and herbicide applications. After growing for 3 to 15 yr, the trees are harvested, chipped, and transported to an energy plant. After several rotations, the rootstock must be replaced, as they will no longer produce vibrant shoots.

Several planting schemes have been suggested for establishing biomass energy plantations. These include single, double, and quadruple row plantings. In a single row planting, one row of trees is planted per bed. Traditional equipment (skidders and feller-bunchers) can be used for harvesting single row plantings. Double- and quadruple-row plantings require specialized harvesting machines similar to those used in European bioenergy plantations.

Conclusions

The concept developed by Sholto and Hart (1985) recognized that farm forests were ecosystems in themselves. They proposed designing forest farms to conform to ecological principles and practices. The systems at least should preserve, and ideally improve, ecological functions. Modern forest farming, whether extensive or intensive and well planned, holds to these principles. The fundamental purpose of forest farming, as suggested by Sholto and Hart (1985), is to integrate the components into a complete stable dynamic system, the components of which support the productive function of the others.

Most contemporary discussions of forest farming include only medicinal plants, other specialty crops, and shade-tolerant plants, yet we consider a broader range of opportunities for forest landowners to farm their lands. A critical feature that distinguishes forest farming from other agroforestry systems is that forest farming incorporates shade-tolerant, non-timber forest resources with trees that form a closed canopy and may be grown for timber. These non-timber forest resources are a main component of forest farming. The comanagement of overstory trees with shade-tolerant understory plants is a major objective and challenge of forest farming.

Landowners need to be aware of the advantages and disadvantages of forest farming. Well designed and implemented, forest farming can help improve forest health by increasing plant diversity as well as removing injured or contaminated vegetation. Forest farming can lead to additional income opportunities, as well. Conversely, forest farming may require more and different skills and expertise. Compared with traditional agricultural or forestry commodities, there may be few marketing structures in place, and relatively sparse information regarding crop management. Integrating forestry and farming activities requires broader knowledge to successfully manage the trees, understory, and their interactions. Forest farming can take more time and energy, which may be limiting factors.

In general, landowners may lack the knowledge and expertise to understand and enter the markets for many forest farming products. The task of learning about these new opportunities may be overwhelming for many forest landowners, but for the tenacious and patient entrepreneur, forest farming can be rewarding.

To be successful at forest farming requires more than dedication and perseverance—it also requires the skills to produce quality and consistent products and having a ready market for products. Forest farming is unlikely to take place on public lands in the absence of appropriate property rights, in the form of tenure systems. In Canada and the United States, property right systems for non-timber forest products on publicly owned lands are generally incomplete, or nonexistent. With some exceptions, such as the community forest tenure in British Columbia, most forest tenures in Canada do not include understory species or non-timber resources. Thus, it is likely that most forest farming is, and will continue to be, practiced by owners of private forest lands or those who manage private and public lands together on a fairly small scale. In parts of North America where most forests are publicly owned (such as Western Canada), the absence of institutional arrangements for non-timber resources is a major barrier to the expansion of forest farming.

Seldom do public policies and programs, whether forestry or agriculture, provide much support or encouragement for forest farming. From the perspective of agricultural policy, forest-farmed products may not be considered “crops” for purposes such as crop insurance, marketing assistance, or other government support. In the long-term, therefore, it is important for forest farmers to work with other individuals and organizations with similar aims to attempt to influence government policy and programs in directions that are more supportive of multiple uses of forest lands.

Despite difficulties and challenges, there are many forest farming opportunities for landowners to pursue to generate extra income activities. Those with large holdings of pine forests might think about managing for straw or coinciding pruning activities with evergreen bough markets. A forest landowner with a propensity for growing or digging native plants might do well to investigate starting a landscaping business. If oil and natural gas prices continue to exhibit volatility, forest landowners might consider growing short-rotation woody crops for bioenergy. Those with a partiality to gardening

or animal husbandry could grow mushrooms or raise bees for additional income. Landowners with an inclination for making crafts could collect a variety of forest species that are used for decorative products.

Whichever forest farming alternative is most appealing, the interested landowner should always investigate the costs, benefits and potential pitfalls of each option. Is there a ready market for the products from the new enterprise? If there is a ready market, what barriers might impede a landowner from entering the market? Are there government regulations to be considered? The landowner must have a clear picture of the economics before committing resources to any venture. Economic analysis and financial considerations for each alternative were not covered in this chapter because they depend on the landowner's specific conditions and the market dynamics at the time of analysis. To present economic analyses may mislead the landowner as the situation (i.e., inputs and outputs) could change significantly. Interested landowners need to evaluate whether they have the skills needed to undertake the desired alternative. One of the first things a landowner should do is inventory and identify resources (biological, people, time, and fiscal), habitats, opportunities, and constraints. If possible, invite a forestry consultant, state forestry agency professional, or extension agent to walk the property and discuss possible options. The decision to grow a specific crop or embark on a forest farming alternative, however, is ultimately the potential producer's sole decision. Thus, potential producers will need to identify where the information and resource gaps occur, and assess them against their degree of acceptable risk in pursuing alternatives of interest.

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Study Questions

1. What three major benefits can a landowner realize through forest farming?
2. Discuss the major challenges that a landowner may face before and following the adoption of forest farming as an alternative land use practice.
3. The early visionaries of forest farming maintained that this integrated land use practice had three main components. Name and discuss the three components, and how the forest farming concept has changed through time.
4. What are the major advantages and disadvantages of forest farming?
5. Identify the four primary methods of generating revenue from forest farming products and services. What are the major factors driving the increase in forest farming of ginseng and goldenseal?
6. Describe the evolution of ginseng cultivation in the United States. What were the major challenges in the early production of this medicinal forest product?
7. Identify and discuss the factors that are affecting salal harvest in British Columbia and provide recommendations to reduce the negative effects of these factors.