
Chapter 7: Forest Farming

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- Non-Timber Forest Products
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Trees are planted with ginseng and other profitable medicinal plants in this illustration. Shiitake mushrooms grow on logs nearby, demonstrating another product that can be farmed in a forest.

What is Forest Farming?

Forest farming is the intentional and sustainable cultivation of marketable non-timber forest products (NTFPs) in woodlands with suitable shade and site conditions. This agroforestry practice diversifies forest management and enhances associated income opportunities. It also improves forest composition and structure and long-term health, quality, and economic value.

Forest farmers actively monitor and manage interactions between trees and understory crops with long-term forest health and productivity in mind. Both timber and non-timber crops can be managed on the same forested land, or non-timber crops can be grown in forests where timber harvesting is not possible or desired. Forest farming operations range from very small (< ½ acre) to very large (> 50 acres).

Advantages

- Enhance forest health
- Improve forest composition
- Diversify income opportunities
- Profit from the rising popularity of forest farmed products
- Range of operation sizes possible

Challenges

- Informal or immature markets
- Variable yield
- Limited information available on how to produce crops
- Volatile markets for some products
- Some crops attractive to poachers

What are Non-Timber Forest Products (NTFPs)?

Forest Farming is defined as the intentional and intensive management of forested lands to produce site-appropriate NTFPs. Forest farmers may intentionally manage shade levels in a forest and among understory plants to favor cultivation or enhanced growth of NTFPs with viable markets. NTFPs include a broad range of goods harvested from woodlands. Herbal plants such as ginseng and goldenseal, specialty mushrooms like shiitake and reishi, and wild foods such as fiddlehead ferns and miner's lettuce that grow in a forest are termed NTFPs.

Unlike other agroforestry practices such as alley cropping or windbreaks, where trees are introduced into an agricultural system, forest farming intentionally integrates agricultural techniques into existing or newly established forests to farm NTFPs. While some forest farmers grow NTFPs for personal consumption, many cultivate and harvest with revenue opportunities in mind.

The total value of the NTFP industry is challenging to estimate due to lack of data, and the fact that much of the economic activities associated with NTFPs are considered part of the informal economy, and thus are not reported. Never the less, evidence indicates that the industry contributes significantly to national, regional, and local economies. The value of NTFPs from Federal lands can be estimated using records of issuances of harvest permits, though these data underestimate overall values. From 2004 through 2013, the national forests and Bureau of Land Management generated nearly \$80 million from the issuance of harvest permits (Chamberlain et al. 2013). The total estimated wholesale value of NTFPs from Federal lands over this period exceeds \$9 billion. Since much of the forest land-base in the eastern US is privately held, these figures do not represent the entirety of NTFP economies.

Estimated values of individual products and market segments also indicate significant economic contributions. For example, Chamberlain et al. (2013) estimated the annual market value of wild-harvested American ginseng in 2007 ranged from \$18 million - \$36 million, depending on price. In 2016, retail sales of black cohosh roots were close to \$43 million according to the American Botanical Council. The annual value of maple syrup production exceeds \$100 million (Farrell and Chabot 2012). In 2007, the US exported pine nuts valued at about \$20 thousand, yet imported more than \$54 million of the nuts (Alexander et al. 2011). Each of these figures demonstrates a great capacity for growth of NTFP markets. An example of this growth can

be seen in the estimated sales of herbal supplements, which increased \$530 million between 2013 and 2016 (Smith et al. 2017). These and other data suggest that NTFPs provide significant economic opportunities for forest dwellers.

Types of NTFPs

Forest farmed NTFPs are generally divided into 4 categories:

- Medicinal
- Edible
- Floral
- Decorative and Craft

Medicinal NTFPs. People have collected medicinal plants in forests for as long as they have walked in them. Medicinal substances are used in nutraceutical, herbal health, cosmetic, and other products and derived from a variety of sources. This includes wood (e.g., aromatic oils from cedar), bark (e.g., smooth sumac, slippery elm), buds (e.g., cottonwood), leaves (e.g., catnip, ginseng, ginkgo), roots (e.g., black cohosh, goldenseal), fruit and flowers (e.g., Echinacea, partridgeberry, skullcap, St. John's Wort), and pollen (e.g., ash, maples, pines). Knowledge about medicinal NTFPs often is informal, but formal information regarding cultivation is increasing.

Edible NTFPs. There are a surprising number of forest-grown edible products. They include fiddlehead ferns, mushrooms, nuts, honey, maple syrup, and the fruit, leaves and/ or roots of many herbaceous plants. Demand for these products is consistent and in some cases increasing. Many types of nuts are farmed throughout Midwestern forests, including black walnuts, pecans, hickory nuts and butternuts. Forest farmed food such as shiitake mushrooms and ramps have been highlighted in gourmet magazines and cooking shows. Wild greens are particularly popular right now and include watercress, miner's lettuce, branch lettuce, dandelion, bean salad, and poke sallet. Wild populations of these plants are usually abundant and only need to be tended, not planted. Numerous types of berry species are cultivated and can be used in products ranging

from fresh fruit to jams, jellies, syrups, juices and wines.

Floral/Decorative NTFPs. Forest farmers can cultivate various decorative plant species to be used individually or in decorative arrangements. Galax is valued for its attractive and durable leaves. Holly is valued for its evergreen leaves (in some species) and bright red berries; and witch hazel, redbud, quince, mountain laurel, and rhododendron for their forced flowers. Pine cones, as well as other seed capsules and pods are used in a variety of craft, potpourri, and seasonal products. These products have consistent markets, command substantial prices, and are sold to floral shops and large retailers or wholesalers. Many plants are valued for landscaping; straw harvested in pine forests is frequently used as landscaping mulch.

Specialty Woods NTFPs. A number of species produce specialty woods and materials for use by local artisans in hand crafted products and art. For example, “diamond willow”, which is actually a diseased willow with cankered stems, can be carved and polished by crafts people to create beautiful walking sticks and other items. Smooth sumac, hickory, and aspen saplings are also converted to walking sticks and mass marketed. Burls are carved and turned into bowls. These value-added “art objects” often sell for up to \$100 or more.

Forest Farming Methods

Management requirements differ based on the NTFPs being farmed. For example, medicinal herb production often involves cultivating the forest floor and possible canopy management to create appropriate growing conditions. Small diameter hardwoods that are removed for timber stand improvement, for instance, may be used as logs for mushroom production. In general, forest farming methods range from minimal to intensive, which varies depending on what is being produced but often relates to tradeoffs between time and money.

There are three recognized methods of forest farming:

- woods grown,
- wild-simulated, and
- managed wild populations.

Woods grown is the most intensive and involves comprehensive site preparation and follow-up management. Start-up costs often are high, but the inputs can significantly increase yield. Wild-simulated is less intensive in terms of site preparation and may involve some canopy management and clearing of the forest floor, but once the plants or seeds are planted, little else is done management wise. Compared to woods grown, wild simulated typically renders less volume, but because the inputs are less, the risks are reduced and the returns may be similar. In the case of ginseng, the slower growth and more wild appearance of the roots often command price premiums, resulting in higher returns. Managing wild populations involves tending an existing population of a plant or fungi. It may involve canopy management, removal of competing understory plants, and thinning of plants to provide for better growing conditions. This method requires few inputs, comes with less risk, and usually does not provide high returns, but may be very desirable for products that have unpredictable markets. Lastly, although not a farming method, a landowner might choose to simply wild-harvest (or wildcraft) marketable NTFPs from their forest. If sustainable wild-harvesting methods are used, these plants and fungi should be available for harvest in future years.

Designing a Forest Farming Operation

It is recommended to start small when establishing a forest farming operation. It often takes multiple years to master NTFP cultivation. The first few years are typically filled with a mix of successes and failures in terms of growing and marketing. The next few years are a time to leverage lessons learned to refine production, increase efficiency, and build on developed markets. Starting small

| Forest Farming Method | Management Intensity |
|-----------------------------------|---|
| Woods Grown | Woods grown, also known as forest gardening, is most intensive. In addition to potential thinning of the forest overstory, it often involves clearing undesirable vegetation in the understory and other practices that are more closely related to agronomy (e.g., tillage, fertilization, weeding, and control of disease, insects, and wildlife). Due to costs associated with input levels, forest gardening can be costly and time consuming but can render large NTFP yield. |
| Wild-Simulated | Wild-simulated is the cultivation of NTFPs in natural growing environments. A natural growing environment can deliver products similar in appearance and quality to plants naturally growing in the wild. Rather than administer intensive agronomic practices, wild simulated forest farmers use minimally invasive techniques to expose the soil, and plant seeds or plants. Fertilizers and pesticides are rarely used. Despite potential decreases in total yields, wild simulated products often have higher priced markets when compared to those that are more intensively cultivated. |
| Managed Wild Population | Managed wild populations involves working with plants or fungus that already exist. The forest canopy may be modified to favor growth of desirable NTFPs. Understory plants that are competing with the desired species may be removed. Annual harvests might not be possible. Inputs are very low and yields vary depending on the species and how often it is harvested. |
| Wild-Harvest or Wild-Craft | Wild-harvesting is the harvesting of NTFPs growing naturally in the forest. It is not generally considered forest farming because active management is not involved. There are no inputs and no risks. There are sustainable wild-harvest methods that can be followed to ensure future harvests. |

Each forest farming method has advantages as well as potential drawbacks in terms of time and money, which also varies by crop. For example, woods grown ginseng may result in a greater yield when compared to wild-simulated but per weight value may be lower. Successful forest farmers have a good sense of available markets and NTFP prices and match method and product to maximize revenue.

allows a forest farmer to gain experience and suffer some setbacks without losing large amounts of money. Small areas can be used to test different crops, sites and management practices. Initial operations usually focus on two or three crops, but can include more if markets and labor are not a limiting factor.

Forest farming depends in large part on site conditions that are present and those required by the desired NTFPs. It is necessary to match and maintain appropriate sites to particular NTFPs. For example, if you want to produce floral greens that have a rich, dark green color,

optimum conditions may include less shade than what is required for ginseng cultivation. Over time, changes occur in a mature or a developing forest that may necessitate thinning, planting of additional trees, or providing artificial shade to maintain useful site conditions. Every forest farming operation should contribute to overall forest health and productivity.

Forest Management Considerations

A well-managed forest offers diverse financial opportunities. Managing the understory for NTFPs in addition to other activities such as timber harvesting and habitat improvement can increase revenue and benefit forest health and plant conservation. Success depends on realistic objectives in accordance with time, labor, and site conditions and amendments. Managing site-appropriate species with growth and value potential will help maximize revenue opportunities. While timber harvests are common sources of revenue for woodland owners, it is often several years between cuttings. Forest farming of marketable NTFPs can provide owners with intermediate income opportunities while timber and other salable products mature.

Timber Stand Improvement (TSI) is an intermediate practice that removes trees to improve species composition, stand structure, wildlife values, regeneration, and forest health. Crop tree management is one method for managing woodlands according to site conditions. With this technique, the best performing and most marketable trees are identified and their growth favored by thinning other trees to retain a suitable residual density. Both methods can provide woody material for use in NTFP production. For example, logs from thinning may be repurposed as mushroom substrate or used for terracing in hillside forest farms.

Management of the forest overstory trees will impact forest farming possibilities regardless of the NTFP crop. In each case, the level of light reaching the forest floor will be altered, the implications of which should be considered by forest farmers. To obtain additional details of forest management options, print or request a copy of the document “Forest Management Guidelines ” from the Missouri Department of Conservation online at <https://mdc.mo.gov/sites/default/files/downloads/forestmanagement1.pdf>. (See additional resources at the end

of this chapter). For information on managing timber, contact forestry organizations listed under Additional Resources at the end of this chapter. Also see appendix section four, “The Basics of Selling Timber.”

In forest farming, shade levels can be adjusted by one of two methods:

If there is not enough shade for the understory, additional planting of trees may be necessary. Shade structures made of wood lath, boughs, or polypropylene shade cloth may be necessary to protect the plants until trees mature and natural shade becomes sufficient. If shade levels are too dense, thinning and/or pruning of trees may help create increase the light levels.



Ginseng grows well in this mix of alley cropping and forest farming. Walnut trees provide necessary shade.

Summary

Forest farming is one of five temperate agroforestry practices. Unlike practices that incorporate trees into agricultural systems (e.g., alley cropping and silvopasture), forest farming integrates cultivation into existing or newly established forests. Benefits include providing intermediate and periodic income from crops while timber matures or where timber harvesting is not possible or desirable. Forest farming practices help diversify forest management and provide important and useful products. Management should focus on site conditions and

tradeoffs between time and money in terms of method intensity. It also may be necessary to manage shade levels by thinning, pruning, and/ or adding trees.

Before beginning an enterprise, forest farmers should:

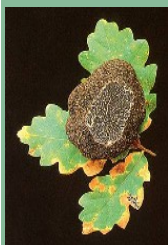
- 1) Identify and investigate existing or developing NTFP markets;
- 2) Select NTFPs of interest from the list of those with viable markets;
- 3) Obtain site requirements, production, and processing information for selected NTFPs;
- 4) Decide on a production method and operational investments; and
- 5) Thoroughly investigate technical resources and engage technical experts.

Markets for forest farmed products vary, but often are direct to consumer and via local stores, cooperatives, or farmers markets. However, in some cases, larger-scale markets are available. For example, shiitake, maitake, morel, and chanterelle mushrooms, as well as truffles, may be sold in small volumes at farmers markets or to gourmet restaurants, or in larger volumes to distributors for resale in regional markets. Markets for decorative products like grape vine wreaths often are in urban areas and may be very seasonal. Decorative products may be sold through cooperatives or to

local buyers. Non-local buyers may be reached through the internet. However, by marketing directly to consumers, a grower is more likely to retain a greater share of profits than when a middleman is involved.

A market analysis and business plan can help a beginning forest farmer chart out required inputs and is an essential starting point. This training manual offers a thorough framework for analyzing specialty crop markets and planning successful farming enterprises (see Chapter 9). Carrying out comprehensive and careful planning during and after startup will help minimize problems and increase chances for long term forest farming success.

Sources of expertise on growing and producing NTFPs can be obtained online from Cooperative Extension's Forest Farming Community of Practice (http://www.extension.org/forest_farming) and in County Extension offices, State Land Grant Universities, the Natural Resources Conservation Service, the USDA Forest Service, State Forestry and Conservation Agencies, and Internet sources (see Additional Resources section).



UMCA Forest Farming Research: Specialty and Gourmet Mushroom Production

Log grown shiitake and other specialty gourmet mushrooms have substantial markets. From gourmet chefs to general household consumers, the awareness and popularity of these edible NTFPs has grown significantly over the past 2 decades.

The University of Missouri Center for Agroforestry (UMCA) leads one of the nation's most comprehensive research programs for shiitake and other gourmet mushrooms in an effort to help develop mushrooms as a profit- able agroforestry crop in the Midwest.



Results indicate that shiitake is a premium, high-dollar mushroom that grows well in Missouri. Research is also being conducted to develop forest farming techniques for morel, truffle and other gourmet mushrooms. Numerous specialty mushroom workshops are hosted nationwide and often bring together researchers, niche-product experts, and landowners to advance specialty mushroom production and markets.

Examples of Forest Farming Products with Markets

Medicinal NTFPs: Ginseng, goldenseal, black cohosh, bloodroot, mayapple, solomon's seal, wild ginger, Oregon- grape, false unicorn (fairywand), ginkgo, skullcap, slippery elm, wild yam, Bethroot, Culver's root (black root), blue cohosh, boneset, lady's slipper, passionflower, partridge berry, hawthorne, pink- root, (indian pink), spikenard, stargrass (devil's bit), stoneroot, Virginia snakeroot, yellow indigo, and yellow root.

Floral/Decorative NTFPs: Grape vines for wreaths; burls for carving; bark, pine needles, wood splints, kudzu, various stems, and bark for baskets; , fall colored leaves and moss for decorations; cuttings from conifers for wreaths, roping, and garlands; salal, pussywillows, ferns, beargrass, and galax for floral greens for use in arrangements; and pine straw for landscaping mulch.

Edible NTFPs: Mushrooms including shiitake, oyster, reishi, morels, maitake, native truffles, and lion's mane; nuts including pecans, black walnuts; fruits and berries including gooseberries and blackberries, crab apples, elderberries, paw paws, and blueberries; vegetables including fiddle heads, ramps, bean salad (rosy twisted stalk), bear grass spiderwort, branch lettuce, burdock, dandelion, dock, miner's lettuce, nettles, poke sallet, sweet salad (Solomon's seal), upland cress (creasy greens), and watercress; syrups including sugar maple and birch; and honey.

Woodland Wildflower NTFPs: Spring ephemerals to be sold as potted plants including celandine poppy, wild geranium, bluebells, Jack-in-the Pulpit, mayapple, and trillium.

Specialty Woods NTFPs: Fine woods for making musical instruments and decorative bowls and plates including curly maple, black walnut, Appalachian red spruce, and eastern red cedar.

Biomass Plants: Willow and poplar grown as short rotation crops; and waste products from timber including sawdust, wood chips, bark, stumps, and branches.

Timber By-products: High quality sawlogs, low quality trees, firewood, and woody residues for energy production.



Left: High value medicinal herb markets have been increasing in recent years.

Right: Pine needles can be harvested into bales and sold for landscaping mulch



Success Stories

Ozark Forest Mushrooms, Timber, Mo.

One of the Midwest's most significant demonstrations of a successful forest farming practice is Ozark Forest Mushrooms near Timber, MO. Dan Hellmuth and Nicola MacPherson established the specialty mushroom operation in 1990 on what was then a timber operation, and together with a small staff, coordinate every step of the value-added process, from the inoculated logs to packaged, consumer-friendly, organic mushroom products.



Nicola MacPherson, right, talks to field day participants about year-round, sustainable shiitake mushroom production, used to extend mushroom production through the winter months.

A key to their success was developing an agroforestry practice that works within the natural setting of the land. Under the guidelines of the Stewardship Incentive Program, administered by the Missouri Department of Conservation (MDC), the couple harvests a renewable supply of oak logs for mushroom production while simultaneously maintaining their forested acres in a healthy ecological state. Consequently, what began with only 100 oak logs in production has grown to include 18,000 shiitake logs in production. Only five acres of the couple's 2,500 forested acres are utilized for the mushroom business.



A greenhouse with a wood furnace for burning spent/culled shiitake logs is used for mushroom cultivation during the cold season and sustainable usage of wood resources.

Ozark Forest Mushrooms gives particular emphasis to targeted marketing of their value-added boxed mixes and products. "The biggest marketing challenge for a rural area is that most of the mushrooms are a fairly high value specialty food, and the largest market is in some of the state's bigger cities," said Hellmuth. "We are marketing products to St. Louis and need to deliver them on a weekly basis."

"It's hard work that doesn't stop," MacPherson said, "but when I walk into a restaurant and see my mushrooms on the menu, or walk into a supermarket and see our products on the shelf, that gives me huge pleasure and makes all the work worthwhile."



Forest farming of log grown shiitake mushrooms, Ozark Forest Mushrooms, Timber, MO.

Additional Resources

Internet Sources: Understory Crops

- eXtension Forest Farming Community - http://www.extension.org/forest_farming
- Appalachian Beginning Forest Farmer Coalition - <https://www.appalachianforestfarmers.org/>
- NC State University Cooperative Extension: (numerous publications) <http://ncherb.org>
- National Agroforestry Center NTFP calculator - <https://www.fs.usda.gov/nac/tools/ntfp.shtml>
- National Agroforestry Center (additional forest farming resources): <https://www.fs.usda.gov/nac/practices/forestfarming.shtml>
- UM Center for Agroforestry: (publications on a variety of products and practices) - <http://www.centerforagroforestry.org/pubs/index.asp#pubs>
- Missouri Alternatives Center: (specialty crops listed) - <http://agebb.missouri.edu/mac/links/index.htm>
- National Sustainable Agriculture Information Service: (numerous publications) - <https://attra.ncat.org/horticultural.html#Agroforestry>
- Opportunities for Enhancing Nontimber Forest Products Management in the United States, *Journal of Forestry*: <https://academic.oup.com/jof/article/111/1/26/4599023>

UMCA DVD

Visit www.centerforagroforestry.org or the University of Missouri Extension web page at <http://extension.missouri.edu/explore/agguides/agroforestry/index.htm> to purchase.

Forest Farming video - <http://www.youtube.com/watch?v=ssFQXgGbwTE>

In Print

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EXERCISE: REVIEW OF FOREST FARMING

1. Identify the top three landowner objectives related to forest farming.

i. _____

ii. _____

iii. _____

2. What are the four general categories of Non-Timber Forest Products?

i. _____

ii. _____

iii. _____

iv. _____

3. What are the four methods of integrating forest farming with wooded environments? Which are the highest input and cost and which are the lowest?

i. _____

ii. _____

iii. _____

iv. _____

4. Identify three products to be produced from the managed land.

i. _____

ii. _____

iii. _____

5. Identify how the landowner can reach their objectives while producing the desired crops.

EXERCISE KEY

1. Identify the top three landowner objectives related to forest farming.

- i. Alternative income from forested land
- ii. Improved forest health
- iii. Improved timber value

2. What are the four general categories of Non-Timber Forest Products?

- i. Medicinal
- ii. Edible
- iii. Floral
- iv. Decoratives and Crafts

3. What are the four methods of integrating forest farming with wooded environments? Which are the highest input and cost and which are the lowest?

- i. Woods grown – highest input and costs
- ii. Wild-Simulated
- iii. Managed wild
- iv. Wild-harvested – lowest input and costs

4. Identify three products to be produced from the managed land.

- i. High quality timber
- ii. Shiitake Mushrooms
- iii. Ginseng

5. Identify how the landowner can reach their objectives while producing the desired crops.

First, identify certain wooded areas that may be more appropriate than others for growing the desired crop. Choose a northerly aspect and well drained site for ginseng production. There can be a bit more flexibility on the mushroom site (but, place it where access is good). Are there sites that are best for just producing timber (soils, aspect, slope position)? Select crop trees to create appropriate shade levels. Thin. Plant ginseng by planned method. Inoculate mushroom logs in an identified area.

Notes