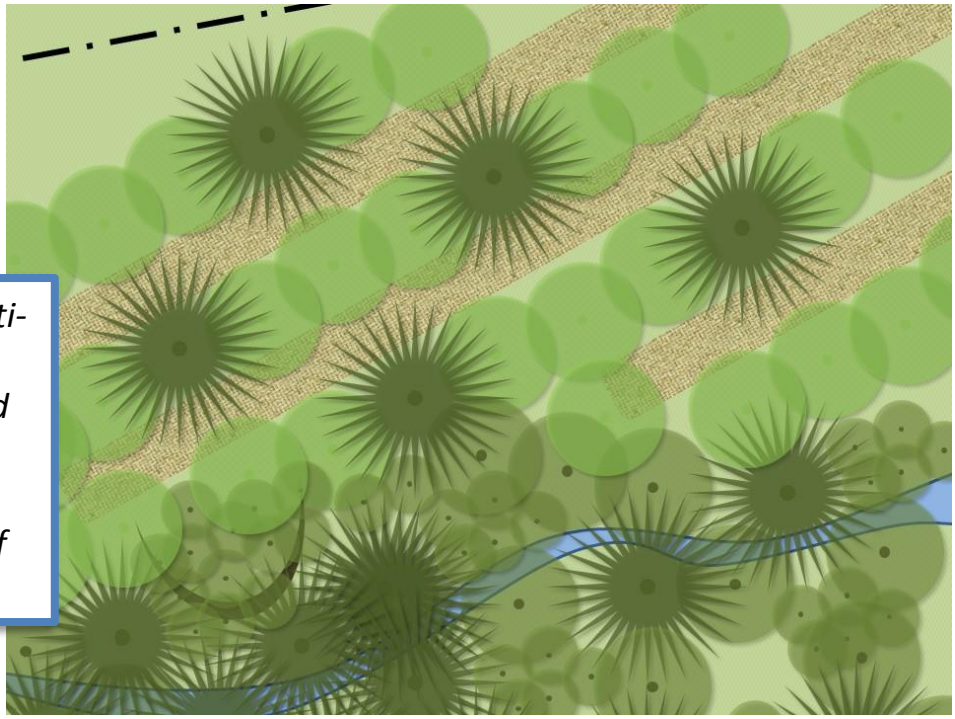
Forest Farming



*"**Forest Farming** is a multi-story cropping system where trees are managed as an overstory with an understory of plants that are grown for a variety of products."*

Description:

Forest Farming or Multi-Story Cropping is the production model that most closely resembles a natural riparian forest, yet provides the opportunity for a farmer to diversify agricultural operations by harvesting both a tree crop and an understory crop. A tree canopy is managed for timber or fruit/nut production or boughs. The understory typically consists of shade-tolerant niche market crops such as medicinal herbs, mushrooms, or greens for the floral market. Establishment of this management system where a tree canopy is not already present, however, presents a multitude of opportunities to grow products at different successional stages of forest development. For example, berries can be grown and harvested during early succession when trees are not yet providing full shade. Farmers may also choose to employ alley cropping or silvopasture working buffer techniques to control weeds and generate income until trees mature and a shaded understory habitat is fully realized.

Depending on the intensity of management and harvest in a Forest Farming system, a riparian buffer may or may not be prescribed between the stream or river and the Forest Farming zone. Forest Farming can be a way for the landowner to increase the riparian buffer size and function while at the same time realizing economic benefits from the land.

Conservation Benefits:

Forest Farming provides landowners with the opportunity to manage a forest and understory for production, while providing the environmental benefits associated with the incorporation of trees and shrubs near stream corridors: shade, microclimate, leaf litter, carbon storage, wildlife habitat, and pollutant filtration. Though management techniques such as thinning of timber, control of understory vegetation, and potential application of pesticides can negatively impact riparian habitat, the proper integration of forest farming techniques with riparian buffers along the stream can provide numerous environmental benefits:

- Incorporating deep rooting trees into agricultural landscapes diversifies rooting depths and increases nutrient and water uptake (Hooper and Vitousek, 1997).
- From a structural perspective, during flood or winter storm events, trees slow moving surface water and encourage infiltration thereby reducing sediment, nutrient, and chemical pollutant runoff (Michel et al., 2007; Jose, 2009). Rows of trees planted either on contour or parallel to the riparian channel can provide a physical barrier to pollutants moving toward a waterway.
- Trees and shrubs provide shade to the stream, maintaining cool water temperatures for fish.
- Incorporating trees into the agricultural landscape increases carbon sequestration both above and below ground (Schoeneberger et al., 2012).
- A forest with an open understory (optional in this management system) creates a unique natural habitat that can enhance nesting site potential (ground and aerial nesting sites), movement of migratory mammals, and increases flowering of trees and shrubs for pollinator habitat when compared to open pasture systems (Garrett et al., 2004; Hinsely and Bellamy, 2000; Varah et al., 2013).
- Trees provide birds with refuge, shelter and forage sites. Bald eagles feeding on salmon carcasses can bring salmon and their nutrients further into the fields aiding in upland fertility.

Landowner Benefits:

Forest farming provides farmers reduced economic risk by managing for a multitude of potential enterprises or personal uses on the same land: timber, high-value medicinals, nursery cuttings, boughs, berries, nuts, mushrooms, etc. In addition:

- Diversifying agricultural revenue sources can provide economic security in the face of potential floods and droughts due to climate change (Schoeneberger et al., 2012).
- Farmers can more intensively manage the understory of the forest to control weeds and reduce competition with the tree crop or adjacent agricultural operations.
- Trees and woody vegetation can increase soil moisture by reducing the evapotranspiration effects of wind, providing shade at certain times of the day, and increasing soil organic matter inputs that can positively affect adjacent agricultural fields (Cleugh, 1998).
- During floods, trees act as a “fence” to trap large wood from the river that would otherwise be deposited on fields or damage fencing.
- Depending on the system, the timing of management, harvest and labor can be staggered throughout the year to provide for year-round income and farm labor employment.

- The Forest Farming systems can provide nesting habitat for both pollinators and predatory insects thus improving the yields of annual crops and reducing the need for pesticides.

Design and Implementation:

The design and implementation of forest farming cropping scenarios is highly dependent on the successional stage and/or health of the existing vegetation where you want to employ this strategy. In general, there are two scenarios we expect most farmers to encounter: planting a forest where none currently exists or modifying an existing riparian buffer where management could improve ecological functions. Initiating forest farming in an intact and healthy riparian forest is not recommended nor is it often allowed under local critical area ordinances/regulations. In most cases, landowners are converting agricultural land or transitioning alley cropping or silvopasture working buffer techniques to a forest farming system. Development of a mature forest requires considerable labor and time investment, therefore, landowners should consider managing the early successional forest for alternative products as trees grow. For example, trees and shrubs that do well in full-sun such as Red Alder, willows and berries can be harvested for economic gain, while longer-term species such as cedar, firs and maples are planted to replace them after harvest. Alternatively, lands where forested riparian buffers already exist, improving the function of the buffer by thinning of deciduous trees and replacement with conifers can provide economic return. In either case, multi-story cropping, much like any managed or un-managed forested landscape is not a static system and management plans should be developed that consider short and long-term economic and production goals.

Landowners have quite a bit of flexibility when designing for the progression of newly planted forest farming scenarios and the associated forest products. One option is to implement silvopasture or alley cropping systems (see other Working Buffer templates) before trees grow to a size that shades out annual crops and forage. Alternatively, there are several high value berry crops that require full-sun to produce that can be planted between trees and replaced once the canopy shades them out. High-yielding fruit-bearing shrubs such as Elderberries, Huckleberries, and Saskatoon can provide high-value crops for wholesale, retail and value added markets. Fast growing, high yielding woody perennials such as Alders, Willow or Cottonwood can be grown initially to improve health of soils, provide shade to surface waters, and filter pollutants. These can be harvested and replaced as the forest transitions to a more conifer-dominated overstory. These fast-growing tree and shrub species can be harvested for firewood, veneer, timber or biomass.

Once the tree canopy matures, several ground-level cropping alternatives can be implemented for high value medicinal, ornamental, nursery, floral or mushroom production. Management of the forest floor should be low intensity with minimal soil disturbance. Species should be selected that can withstand and produce under shade, although the shade level can be managed to some extent through thinning of the forest canopy. Already established native vegetation provides the opportunity for nursery seed and vegetative propagation

to meet the high demands of restoration projects throughout the region (Buttolph and Jones, 2012). An opportunity for forest-farming producers is available for "wild-simulated" medicinal herb production (Thomas and Schumann, 1993; Chamberlain and Hammet, 2002; Adams, 2004). These species include Goldenseal, Oregon Grape, American Ginseng, Blue/Black Cohosh, and Devils Club to name a few high yielding and important species for biodiversity preservation and cultural use. Management for mushrooms, whether wild-crafted species (e.g. chanterelles, chaga, or boletes) or mushrooms inoculated into hardwood substrates provides additional opportunities to capture the benefits of the shady, moist microclimate of riparian forest buffers.

Below is a table of selected perennial species, ideally suited to marketable or farmstead resource production for forest farming cropping systems in the Puget Sound Region. This is not an exhaustive list of potential species but rather those species that present current, high-value commercial marketability. Additional information can be found in the *Nontimber Forest Product Resources for Small Forestland Owners and Business Database* at http://www.ntfpinfo.us/.

Suitable Tree Species for PNW Forest Farming				
Common Name	**Family**	**Genus**	**Harvestable Material**	**Notes**
Canopy Layer				
Chestnuts	*Fagaceae*	*Castanea*	Nuts	High value nut and timber
Walnuts	*Junglandaceae*	*Juglans*	Nuts	High value nut and timber, Black, European and Persian
Butternuts	*Junglandaceae*	*Juglans*	Nuts	High value nut and timber, prefers drier sites
Heartnuts	*Junglandaceae*	*Juglans*	Nuts	High value nut and timber, withstands wetter conditions
Hickory	*Junglandaceae*	*Carya*	Timber, Nuts	High value timber and nut
Maple	*Aceraceae/Sapindaceae*	*Acer*	Timber and Syrup	Potential niche market
Yellowhorn	*Sapindaceae*	*Xanthoceras*	Ornamental/Nut	Chinese native with traditional culinary uses
Cedar	*Cupressaceae*	*Thuja*	Ornamental/Timber	Large market and distribution available
Spruce	*Pinaceae*	*Picea*	Ornamental/Timber	Large market and distribution available
Fir	*Pinaceae*	*Abies*	Ornamental Timber	Large market and distribution available
Stone Pines	*Pinaceae*	*Pinus*	Nuts	Korean and Italian Stone pines or pine nuts
Turkish Tree Hazel	*Betulaceae*	*Corylus*	Nuts	Large, stress tolerant tree produces heavy shade
Monkey Puzzle	*Araucariaceae*	*Araucaria*	Nuts	Large and abundant nut producer
Early Succession/ Forest Edge				
Alder	*Betulaceae*	*Alnus*	Timber and Syrup	Furniture, firewood and syrup
Birch	*Betulaceae*	*Betula*	Timber and Syrup	Furniture, firewood and syrup
Hybrid Poplar	*Salicaceae*	*Populus*	Timber and Syrup	Biomass, firewood and syrup
Black Cottonwood	*Salicaceae*	*Populus*	Timber and Syrup	Biomass, firewood and syrup
Cascara	*Rhamnaceae*	*Rhamnus*	Medicinal Bark	Large market and distribution available
Oaks	*Fagaceae*	*Quercus*	Timber, Bark, Nuts	White, Cork, Oregon Species. Prefers well drained sites
Elderberry	*Caprifoliaceae*	*Sambucus*	Fruit	High value fruit
Crabapple	*Roseaceae*	*Malus*	Rootstock	Grafter to high value fruit
Apple	*Roseaceae*	*Malus*	Fruit/Timber	High value cider market and wood product
Pear	*Roseaceae*	*Pyrus*	Fruit	Cider production source
Plum	*Roseaceae*	*Prunus*	Fruit	Local high value fruit
Cherry	*Roseaceae*	*Prunus*	Fruit/timber	High value fruit and hardwood
Quince	*Roseaceae*	*Cydonia*	Fruit	High value fruit
Fig	*Moraceae*	*Ficus*	Fruit	High value fruit
Mulberries	*Moraceae*	*Morus*	Fruit	Great mast crop and high value fruit
Huckelberries	*Ericaceae*	*Vaccinium*	Fruit	Marketable native with potential for further domestication
Saskatoon	*Rosaceae*	*Amelanchier*	Fruit	High value fruit, superfood
Salmon Berry	*Rosaceae*	*Rubus*	Fruit	Marketable native with potential for further domestication
Hawthorne	*Rosaceae*	*Crataegus*	Medicinal Fruit and Flower	Highly marketable native species

Sumac	*Anacardiaceae*	*Rhus*	Fruit	High value culinary spice
Aronia	*Roseaceae*	*Aronia*	Fruit	High value fruit, superfood
Currants/Gooseberries	*Grossulariaceae*	*Ribes*	Fruit	High value fruit, native and non native
Hardy Kiwi	*Actinidiaceae*	*Actinidia*	Fruit	High value fruit for local markets, superfood
Ground Covers				
Nettles	*Urticaceae*	*Urtica*	Aerial Parts	High value vegetable for local markets
Miners Lettuce	*Montiaceae*	*Claytonia*	Aerial Parts	High value vegetable for local markets
Oregon Grape	*Berberidaceae*	*Mahonia*	Fruit/Medicinal Root	Berberine alkaloid popular medicinal nationwide
Salal	*Ericaceae*	*Gaultheria*	Fruit/Ornamental	Ornamental cut greens and berries
Devils Club	*Araliaceae*	*Oplopanax*	Root	High value medicinal
American Ginseng	*Araliaceae*	*Panax*	Root	Extremely high value , International markets
Goldenseal	*Ranunculaceae*	*Hydrastis*	Roots/Rhizome	High value medicinal herb, high demand
Black/Blue Cohosh	*Ranunculaceae*	*Acteae*	Roots/Rhizome	High value medicinal
Arnica	*Asteraceae*	*Arnica*	Flower	High Value medicinal
Ramps	*Amaryllidaceae*	*Allium*	Stalk and bulb	High value culinary with high demand
Water Cress	*Brassicaceae*	*Nasturtium*	Leafy greens	Traditional vegetable with local demand
Wasabi	*Brassicaceae*	*Eutrema*	Root	High value root crop with international market demand
Ostrich Fern	*Dryopteridaceae*	*Metteuccia*	Spring Fiddleheads	Potential high value fiddelhead fern
Mushroom				
Shiitake	*Marasmiaceae*	*Lentinula*	Fruitbody	High value with local demand
Maitake	*Meripilaceae*	*Grifola*	Fruitbody	High value with local demand
Oyster Mushroom	*Pleurotaceae*	*Pleurotus*	Fruitbody	High value with local demand, cultivated or wildcrafted
Turkey Tail	*Polyporaceae*	*Trametes*	Fruitbody	High value with local demand, cultivated or wildcrafted
Reishi	*Ganodermataceae*	*Ganoderma*	Fruitbody	High value with local demand, cultivated recomm.
Chaga	*Hymenochaetaceae*	*Inonotus*	Fruitbody	High value with local demand, wildcrafted recomm.
Truffle	*Tuberaceae*	*Tuber/Leucangium*	"Tuber" or Sclerotia	High value potential, native to PNW

Pacific Northwest Production Models:

Forest Farming and multi-story cropping can provide the most diverse economic benefit for landowners interested in achieving environmental stewardship in riparian corridors. Below are a few examples of highly marketable species, both domestically and internationally, gaining popularity and research interest in the Puget Sound region.

Pine Nuts (Pinus Spp.): Pine nuts, produced primarily in the Southeast U.S., are a high demand and extremely productive and valuable nut crop. In the U.S., the pine nut is a $100 million market, though 80% of these nuts are imported (Sharashkin and Gold, 2004). Pine nuts come from several species of pine, most notable of the commercially viable species are the Siberian (*Pinus sibirica),* Korean stone pine (*Pinus koraiensis*), Chilgoza pine (*Pinus gerardiana*), Italian Stone pine (*Pinus pinea*) and the few native to the U.S. are Colorado pinyon (*Pinus edulis*) and Single-leaf pinyon (*Pinus monophylla*). Italian Stone pine and Korean stone pine are the two species that provide most commercially viable potential west of the cascades, yielding upwards to 100lbs/acre shelled nuts when planted in ideal conditions (Geisler, 2013). Sharashkin and Gold (2004) report that shelled nuts, the most expensive nut on the market, range from $20-$35/kg and $70-$140 per liter of pine nut oil. Producers can earn more if it is sold as a flour or the oil is marketed as a medicinal product (Sharashkin and Gold, 2004). WholesalePineNuts.com is currently marketing bulk U.S. grown pine nuts for $13.49-$14.99/lb in 2015. Additional research and experimentation for production in the Puget Sound region is needed.

Elderberries (*Sambucus Spp.):* Elderberry is a very well known medicinal plant throughout the U.S. and Europe and the use and cultivation for berries by Native American cultures has been well documented (Turner and Peacock, 2005; Moerman, 1998). Black Elderberry (*Sambucus nigra*) is currently produced commercially for

juices, wine and medicinal tonics in Europe. More recently in the U.S., much attention has turned to our native species of Elderberries for their prized culinary and medicinal attributes. In Western Washington there are two native species of elderberry, Red Elderberry (*Sambucus racemosa*) and Blue Elderberry (*Sambucus caerulea*), though the Blue elderberry is primarily harvested for it's sweeter juices for making jams, sweeteners, wines and liquors. In the Midwest and Eastern U.S., research into the value of elderberry (primarily *Sambucus canadensis)* is aiding in developing of this market. A recent study by the University of Missouri's Center for Agroforestry describes a multitude of economic uses including nursery plants ($6/plant) and fresh berries ($.50/lb to winery, $1.25/lb U-Pick, $3lb de-stemmed, $5/lb to winery de-stemmed, and $11/lb to dietary supplement manufacturers). Average prices for processed juice range from: wine ($10-$14/bottle), fresh juice ($12-$17/11oz bottle retail) and juice concentrate ($25/375ml bottle retail) (Byers et al., 2014). Elderberries are an extremely productive species, with some domesticated cultivars providing fruit within the first year after planting and producing up to 12,000 lbs/acre in intensive commercial plantings (Stafne, 2006).

Goldenseal (*Hydrastis canadensis*): Goldenseal is a member of the Ranunculaceae family and is native to the eastern North American continent. High domestic and international market demand for this species has caused wild populations to diminish across the continent resulting in being listed as "threatened" on the U.S. Endangered Species List as well as being on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) list since 1997 (Predney and Chamberlain, 2005). Current markets are seeking sustainable "wild-simulated" sources of goldenseal throughout the country. A few producers in western Washington are contracting with Mountain Rose Herbs and other medicinal product wholesalers, proving production viability in the Puget Sound region. Goldenseal requires consistently moist soils under closed canopy shade and is therefore, ideally suited for riparian buffer production. Yield estimates range from 1,000-2,500lbs/acre every 3-5 years when harvested under artificial shade production, though some suggest that this may be a low estimate (Burkhart et al., 2006). In 2012, researchers at North Carolina State University found producers receiving $30-$35/lb of dried root from wholesalers while retail averaged about $115/lb dried root. Current retail pricing at Mountain Rose Herbs is $93/lb of dried root. Sego's Herb Farm in La Center Washington produces goldenseal under artificial shade for the wholesale market. They have produced a production budget, published on the WSU Small Farms Team website, detailing 8,000lbs of fresh (wet) root production on one acre and receiving $15/lb in 2001. See http://smallfarms.wsu.edu/crops/medicinalherbs/organicGoldenseal.html for more information.

Shiitake (*Lentinula edodes*): Shiitake mushrooms are a species of saprophytic (decomposing) fungi that produce fruit bodies (mushrooms) on decomposing hardwood branches and trunks. Native to Asia, this highly prized edible mushroom species is currently in high demand in the restaurant and retail markets. Demand for Shiitakes, one of the two most popular mushroom species in the world (Davis and Harrison, 2011),

outpaces production nationwide. Shiitakes can be produced as an alternative enterprise within your riparian buffers in a process known as log culture. Shiitake spawn is plugged into holes drilled within hardwood (alder) logs and stacked until fruiting. Producers can expect to begin harvest within a year after inoculation and logs can produce for up to 5 years. Research conducted on market pricing has shown a wide range of wholesale and retail pricing ranging from $4-$8/lb and $10-$20/lb respectively (Frey, 2014; Bruhn, 2008) with an estimated yield of 500lbs per every cord of wood inoculated (Davis and Harrison, 2011). Shiitakes can be sold fresh and dried in order to help provide consistent income throughout the year from wholesale and retail sales.

Financial Assistance and Cost Share Opportunities

Financial assistance in the form of cost-share funds or public subsidies can aid landowners interested in implementing forest farming or multi-story cropping management practices. Agencies currently equipped to provide this funding, including implementation funds and technical assistance, can be secured through the following agencies and programs:

- Conservation Districts – Local conservation districts can help to provide technical assistance and planning, and seek funds though the Washington State Conservation Commission and other local funding sources.
- National Resource Conservation Service (NRCS) – EQIP and CSP programs. Contact your regional NRCS Field technician for application details: http://www.nrcs.usda.gov/wps/portal/nrcs/main/wa/contact/local/

Sources of Funding and Assistance

- USDA Farm Service Agency – Conservation Reserve Enhancement Program (CREP)
- NRCS – Environmental Quality Improvement Program (EQIP)
- NRCS – Conservation Stewardship Program (CSP)
- Washington Conservation Commission – Livestock and Shellfish Funding Programs
- Department of Ecology – Pollution Identification and Correction (PIC) program
- Local Conservation District, NGO, and other Environmental Protection Partnerships

Approved WA NRCS Best Management Practice Standards:

The NRCS provides Best Management Practice (BMP) standards for Washington State to ensure cost-share subsidies are used appropriately for the natural resource concerns to be addressed. The following NRCS BMP standards have been developed in accordance to state environmental policy specifically addressing natural resources management within agricultural landscapes:

Multi-Story Cropping (512): Provides resources for implementing practices within established forest or newly planted forest whereby the intent is to manage the understory for multiple non-timber forest products while concurrently managing the canopy overstory.

Riparian Forest Buffer (391): Establishing plantings along riparian corridors. The standard encourages “tree and shrub species that have multiple values such as those suited for timber, biomass, nuts, fruits, browse, nesting, aesthetic and tolerance to locally used herbicides (NRCS, 2007).”

Tree/Shrub Establishment (612): Establishing the planting of trees and shrubs for a multitude of conservation and agricultural purposes. Within this practice standard, priority has been established for the development of renewable energy systems.

Plant Enhancement Activity – PLT18 – Increasing on-farm food production with edible woody buffer landscapes: As part of the their Conservation Stewardship Program, NRCS has recently added this enhancement funding source to provide resources for enhancing windbreaks, alley cropping, silvopasture and riparian forested buffers with trees and shrubs that provide food for human and wildlife consumption.

Plant Enhancement Activity – PLT05– Multi-story cropping, sustainable management of nontimber forest plants: As part of the their Conservation Stewardship Program, NRCS has recently added this enhancement funding source to provide resources for enhancing forest and croplands where the forest is managed for harvestable non-timber plants in addition to or instead of timber.

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