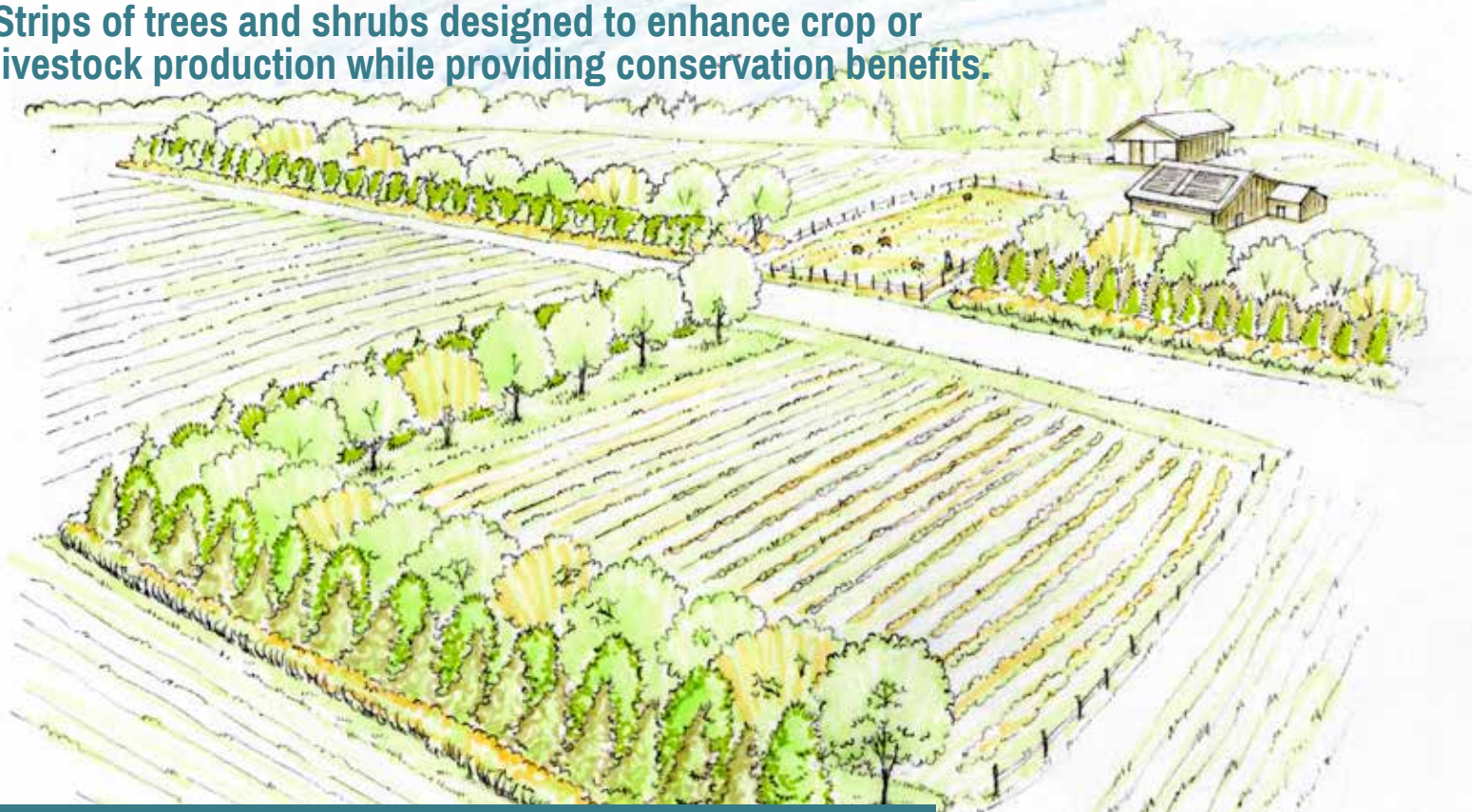
SAVANNA INSTITUTE

UNDERSTANDING AGROFORESTRY

Windbreaks

Strips of trees and shrubs designed to enhance crop or livestock production while providing conservation benefits.



BENEFITS

Economic

ENERGY COST REDUCTION: Reduces heating and cooling needs for living and working space by reducing indoor air exchange caused by wind.

HIGHER CROP YIELDS: Protects wind-sensitive crops and can increase total yields and crop quality.

SHADE PROVISION AND WIND PROTECTION FOR LIVESTOCK: Trees shade during the heat of the summer and provide protection from the wind.

DIVERSIFIED INCOME/FOOD SECURITY: Trees and shrubs planted in windbreak can be cultivated as food, fiber, and fodder to be marketed or used for subsistence purposes.

Ecological

SOIL HEALTH: Reduces soil loss caused by wind.

GREATER WATER AVAILABILITY to nearby crops due to lower evapotranspiration rates via reduced wind speed and the effects of catching snow.

ODOR AND POLLUTANT BLOCKAGE: Trees filter and block dust, drifting pesticides, and odors from nearby farms and homes.

WILDLIFE HABITAT AND CORRIDORS: Provides resources for pollinators and refuge for beneficial insects that control pests on farm.

CHALLENGES

FINANCIAL INVESTMENT: Requires farm to take area out of commodity crop production. Incorporating tree and shrub crops into windbreak helps to offset loss in acreage.

POTENTIAL TRADEOFFS: If windbreak design is intended to meet a combination of economic and ecological objectives, there may be tradeoffs in performance and/or cost among potential designs.

HIGH INITIAL INVESTMENT, SLOW RETURN: Including crop-producing trees and shrubs can require high maintenance (pruning, herbivory prevention, and weed control) in initial years when there are not yet returns via harvest.

PUTTING IT INTO PRACTICE

Frequently Asked Questions

DESIGN CONSIDERATIONS?

HEIGHT AND LENGTH: height determines how far downwind protection will reach and length determines total area protected.

DENSITY: can be managed by plant species chosen. Higher windbreak density provides greater wind speed reduction.

ORIENTATION: windbreaks are most effective when oriented at right angles (L or U shapes).

PLACEMENT: windbreaks should be placed on windward sides of fields. Both summer and winter wind directions should be considered.

WHAT TO PLANT?

Species composition can greatly impact the effectiveness of a windbreak. Species may include fruit and nut producing shrubs and trees for an edible windbreak. Recommended planting plan with rows listed windward to leeward.

ROWS 1-2: Short, dense shrubs. (e.g. willow, hazelnut, brambles, currants, elderberry)

ROWS 3-4: Tall shrubs or short broadleaf trees. (e.g. plum, persimmon, serviceberry)

ROWS 5-6: Dense, mixed conifers.

ROWS 7-8: Tall broadleaf hardwoods. (Can also be mixed with fast growing trees, such as hybrid poplar, for a quick windbreak that will transition to the hardwoods over time.)

MANAGEMENT?

Proper care for windbreaks is critical for long-term functioning. Weeding, pest and disease monitoring/ control, protection from livestock and wildlife damage, pruning or replanting, and supplemental watering may be needed on a continuing or periodic basis.

FUNDING AND PLANNING ASSISTANCE?

Connect with the local conservation district and extension offices to learn about federal and state cost-share programs such EQIP, CRP, and CSP. These offices can also provide connections with regional consultants and technical service providers.

The Savanna Institute is a 501(c)(3) nonprofit organization working to catalyze the development of and adoption of resilient, scalable agroforestry in the Midwest US. We work in collaboration with farmers and scientists to develop perennial food and fodder crops within multifunctional systems grounded in ecology and inspired by the savanna biome. The Savanna Institute strategically enacts this mission via research, education, and outreach.

SARE Sustainable Agriculture Research & Education

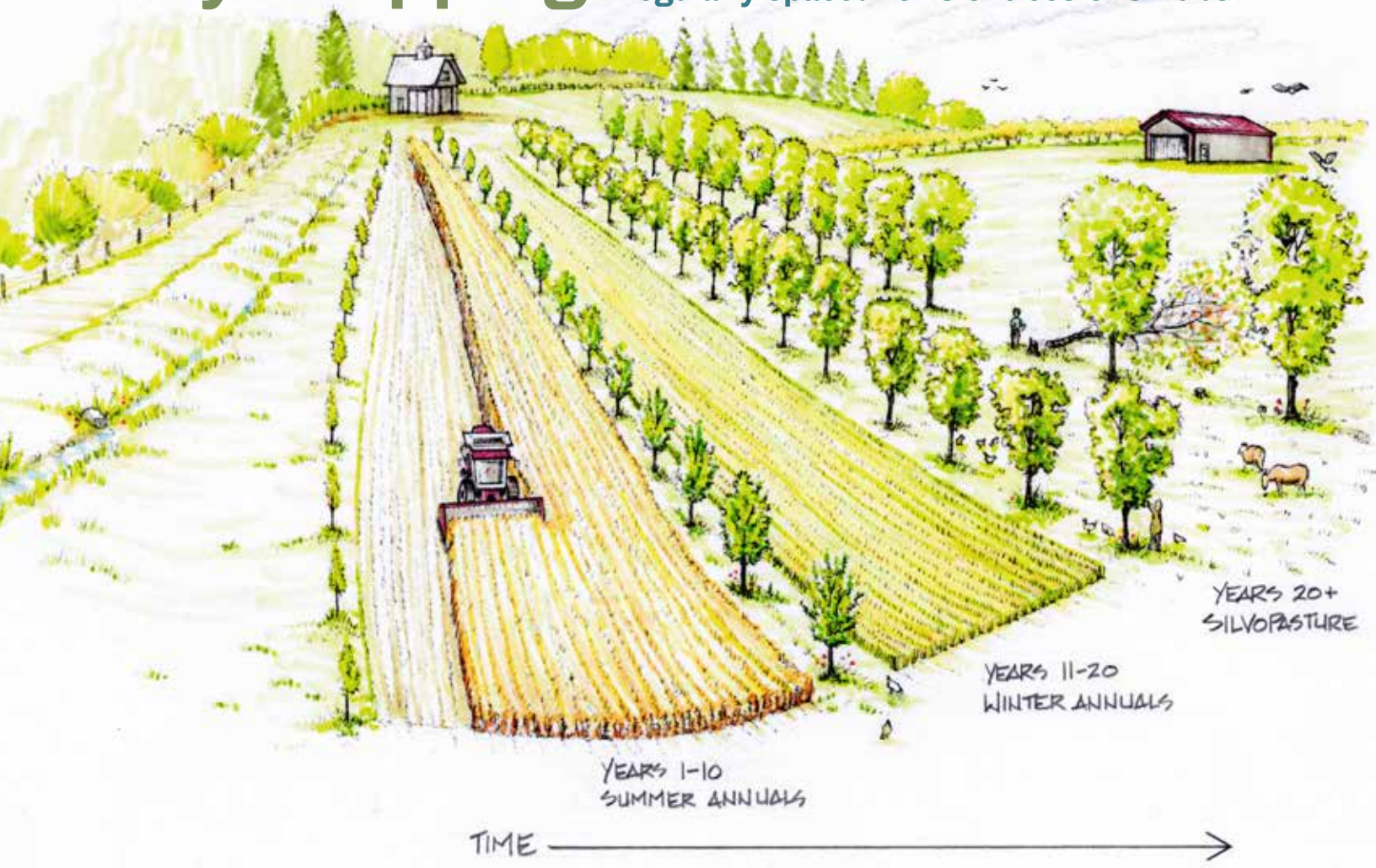
This product was developed with support from the Sustainable Agriculture Research and Education (SARE) program, which is funded by the U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). Any opinions, findings, conclusions or recommendations expressed within do not necessarily reflect the view of the SARE program or the U.S. Department of Agriculture. USDA is an equal opportunity employer.

SAVANNA INSTITUTE

UNDERSTANDING AGROFORESTRY

Alley Cropping

The cultivation of crops in the alleys between regularly spaced rows of trees or shrubs.



BENEFITS

Economic

INCOME STABILITY through diversified revenue streams from trees and crops.

HIGHER LAND-USE EFFICIENCY: Tree roots capture nutrients that crops cannot access, thereby increasing the productive potential of the land.

CROP YIELD STABILITY: Trees reduce wind stress on crops, stabilize crop temperatures, and reduce evaporation of water from soil.

Ecological

CARBON SEQUESTRATION in woody perennials and soil organic matter.

SOIL HEALTH AND FERTILITY: Trees reduce soil erosion, nutrient leaching, soil compaction, and water runoff.

PEST AND DISEASE SUPPRESSION: Perennial crop structural diversity provides habitat for natural enemies.

POLLINATOR AND WILDLIFE HABITAT via structural diversity and uncropped area within tree rows.

CHALLENGES

INCREASED COMPLEXITY of management interventions and required farmer skill set.

CHANGING ALLEY CROP OVER TIME as tree-crop competition increases.

HIGH CAPITAL INVESTMENT in initial tree and shrub establishment.

LONG-TERM LAND TENURE required to realize the full profitability/benefits of trees.

PUTTING IT INTO PRACTICE

Frequently Asked Questions

WHAT TREES/SHRUBS TO PLANT?

Timber trees require low capital investment and minimal ongoing maintenance. Fruit and nut trees require higher investment and maintenance, but can provide higher, earlier, and annual returns.

Additional shrubs/other perennial crops can be planted within the tree rows between the primary trees. Since mechanical harvest is difficult between trees, this area should focus on hand-harvestable species (e.g. elderberry, red currants, decorative stems/flowers).

Since mechanical harvest is difficult within tree rows, this area should focus on hand-harvestable species (e.g. elderberry, red currants, decorative stems/flowers).

WHAT CROPS TO GROW?

The alley crop will change over time to optimize productivity during different phases of tree maturity. For example:

YEARS 1-10: Sun-loving summer annuals (corn, soybean, vegetables)

YEARS 11-20: Winter annuals with a growing season complementary to the trees (wheat, barley, oats)

YEARS 20+: Crops with deep roots and shade tolerance (forages, shrub fruits), with possible transition to a silvopasture system.

MECHANICAL HARVEST?

Systems dimensions are designed to allow standard mechanical crop management. Mechanical harvest of trees (nuts, fruits, timber) can be completed after crop harvest.

PLANTING DIMENSIONS?

ALLEY WIDTH between tree rows is typically a multiple of the width of the alley crop farmer's widest implement.

WITHIN-ROW TREE SPACING depends on the mature canopy size of trees.

UNCROPPED AREA within tree rows is kept as narrow as possible while still permitting access for periodic maintenance.

FUNDING AND PLANNING ASSISTANCE?

Connect with the local conservation district and extension offices to learn about federal and state cost-share programs such EQIP, CRP, and CSP. These offices can also provide connections with regional consultants and technical service providers.

The Savanna Institute is a 501(c)(3) nonprofit organization working to catalyze the development of and adoption of resilient, scalable agroforestry in the Midwest US. We work in collaboration with farmers and scientists to develop perennial food and fodder crops within multifunctional systems grounded in ecology and inspired by the savanna biome. The Savanna Institute strategically enacts this mission via research, education, and outreach.

SARE Sustainable Agriculture Research & Education

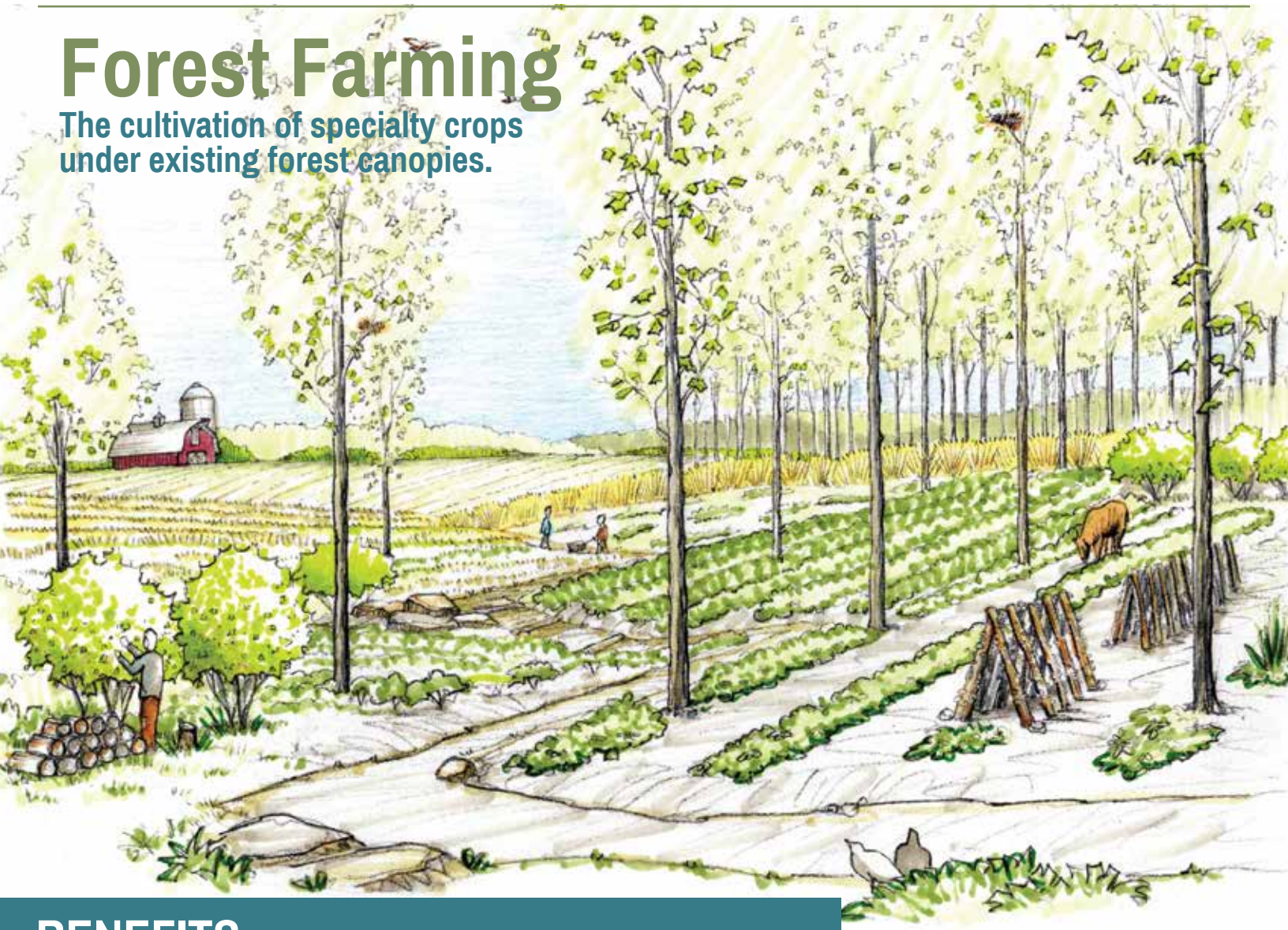
This product was developed with support from the Sustainable Agriculture Research and Education (SARE) program, which is funded by the U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). Any opinions, findings, conclusions or recommendations expressed within do not necessarily reflect the view of the SARE program or the U.S. Department of Agriculture. USDA is an equal opportunity employer.

SAVANNA INSTITUTE

UNDERSTANDING AGROFORESTRY

Forest Farming

The cultivation of specialty crops under existing forest canopies.



BENEFITS

Economic

INCREASED INCOME GENERATION: Farming in the woods can be done without major disturbance and provide additional income in forests typically just managed for timber.

FLEXIBILITY IN MANAGEMENT: Intensive to minimal, depending on the product and desired market.

COMPLEMENTS EXISTING PRODUCTION SYSTEMS: Uses resources that would otherwise be underutilized.

Ecological

LOW IMPACT: Does not interfere significantly with the ecosystem services forests already provide.

INVASIVE SPECIES MANAGEMENT: Management of forest understory for production can displace invasive species that often otherwise occupy this area.

CHALLENGES

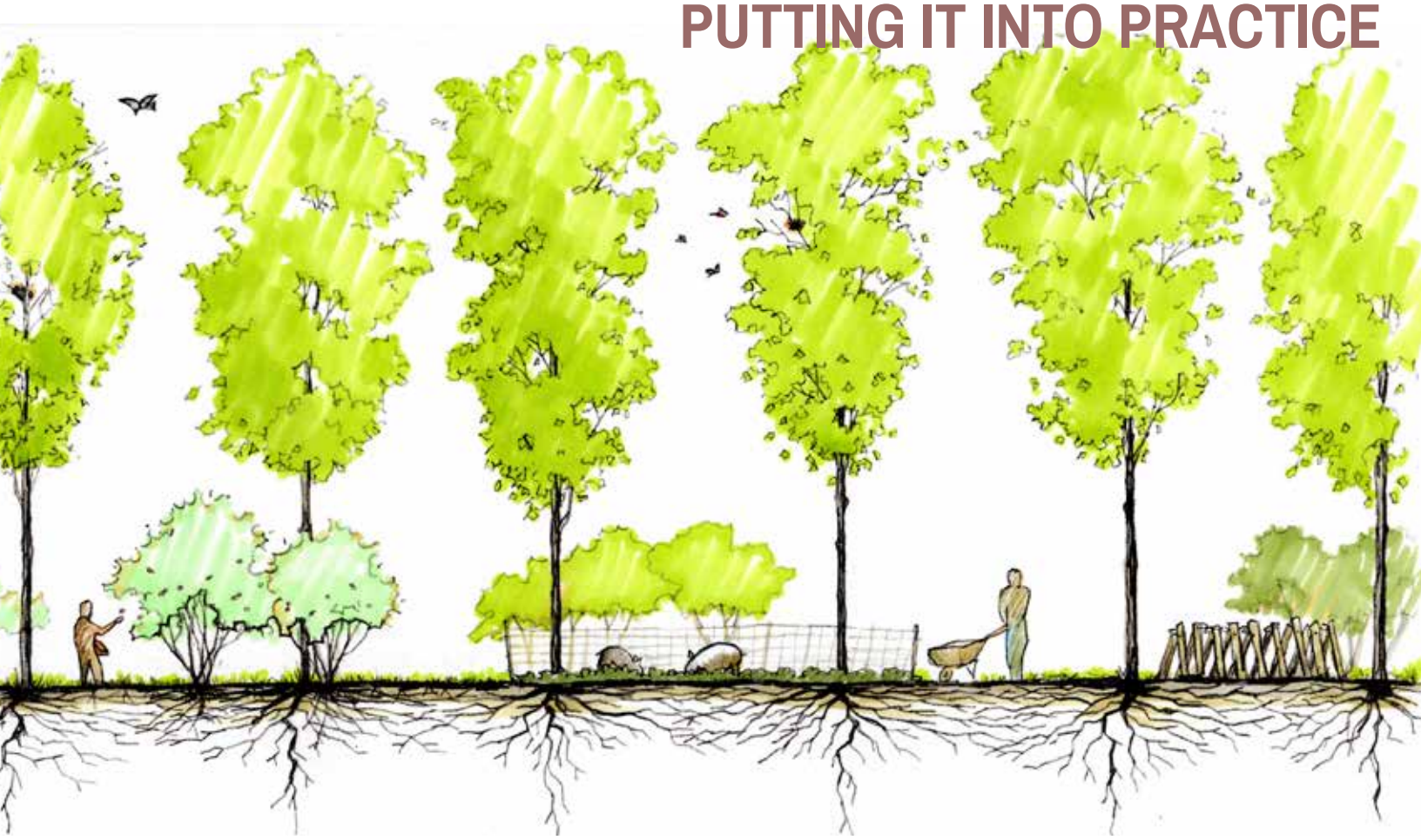
LONG-TERM CROPS ARE AT RISK OF:

- Disease outbreaks and pests.
- Soil fertility loss.
- Crop loss due to poaching or weather.
- Shortage of processing facilities.

MARKET ESTABLISHMENT is a time intensive and long-term process.

DETAILED RECORD-KEEPING AND MARKET RESEARCH is required for selected products.

PUTTING IT INTO PRACTICE



Frequently Asked Questions

SITE SELECTION AND PREPARATION?

Consider slope and aspect, tree cover, soil quality, and understory vegetation when selecting forest farming site and preparing it for a particular crop.

FUNDING AND PLANNING ASSISTANCE?

Connect with the local conservation district and extension offices to learn about federal and state cost-share programs such EQIP, CRP, and CSP. These offices can also provide connections with regional consultants and technical service providers.

WHAT CROPS TO GROW?

A variety of non-timber forest products can be cultivated in the understory of the forest.

CULINARY: mushrooms (shitake, matsuki, oyster), ramps, gooseberry, currant

ORNAMENTAL: club fern, spanish moss, shade-tolerant cut flowers and stems

MEDICINAL: ginseng, goldenseal, elderberry

FINDING MARKETS?

Markets for non-timber forest productss include direct to consumer, restaurants, to wholesale depending on the product.

Determine and familiarize yourself with selected markets before selecting and planting product to determine appropriate planting rate.

The Savanna Institute is a 501(c)(3) nonprofit organization working to catalyze the development of and adoption of resilient, scalable agroforestry in the Midwest US. We work in collaboration with farmers and scientists to develop perennial food and fodder crops within multifunctional systems grounded in ecology and inspired by the savanna biome. The Savanna Institute strategically enacts this mission via research, education, and outreach.

SARE Sustainable Agriculture Research & Education

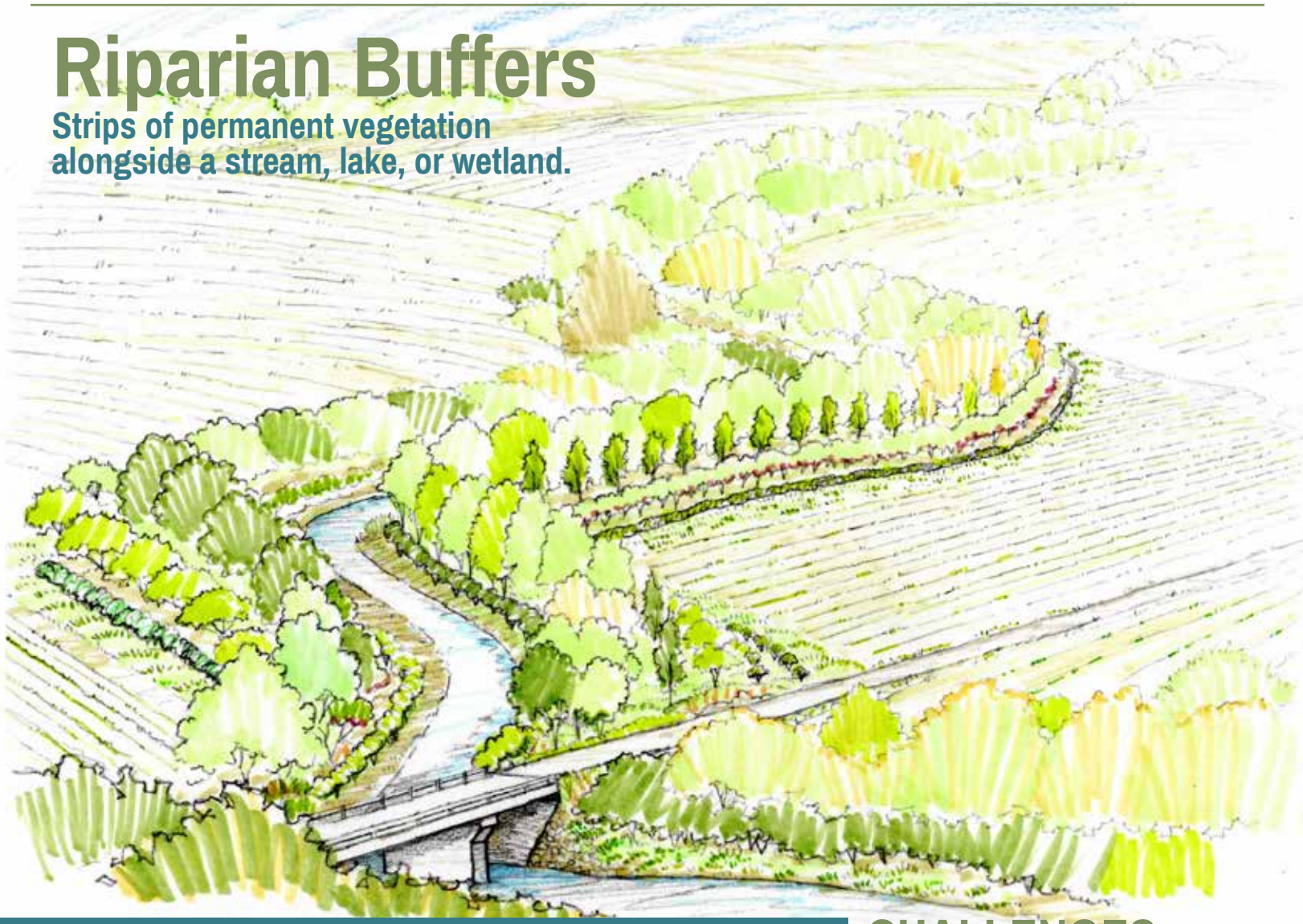
This product was developed with support from the Sustainable Agriculture Research and Education (SARE) program, which is funded by the U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). Any opinions, findings, conclusions or recommendations expressed within do not necessarily reflect the view of the SARE program or the U.S. Department of Agriculture. USDA is an equal opportunity employer.

SAVANNA INSTITUTE

UNDERSTANDING AGROFORESTRY

Riparian Buffers

Strips of permanent vegetation alongside a stream, lake, or wetland.



BENEFITS

Economic

PRODUCES INCOME FROM MARGINAL FARMLAND by using resources that are otherwise underutilized due to frequent flooding and poor yields.

DIVERSIFIED INCOME AND FOOD SECURITY from trees, shrubs, and other perennial plants that can be cultivated as food, fiber, and fodder for sale or subsistence purposes.

PROTECTS CROPS by buffering floods.

Ecological

WILDLIFE HABITAT AND CORRIDORS provide resources for pollinators and refuge for beneficial insects that control pests on farm.

EROSION STABILIZATION via above ground foliage and below ground roots that slow run-off, trap sediment, and prevent channelization of streams.

FILTERS NUTRIENTS, PESTICIDES, AND SEDIMENT from runoff. Below-ground roots can take up excess nutrients.

CHALLENGES

FINANCIAL INVESTMENT requires farm to take area out of commodity crop production. Incorporating productive tree and shrub crops into buffer helps to offset loss in acreage.

POTENTIAL TRADEOFFS: There may be trade-offs in performance and/or cost among designs intended to meet a combination of economic and ecological objectives.

HIGH INITIAL INVESTMENT, SLOW RETURN: Including crop-producing trees and shrubs can require high maintenance (pruning, herbivory prevention, and weed control) in initial years when there are not yet returns via harvest.

PUTTING IT INTO PRACTICE

Frequently Asked Questions

BUFFER SIZE AND SHAPE?

Should be based on intended goals.

NARROW: stabilize bank and trap sediment

MEDIUM-WIDTH: enhance aquatic and terrestrial habitat

WIDE: filter soluble nutrients

CAN I HARVEST CROPS FROM THE BUFFER?

If food- and fodder-producing species are included in the buffer, harvesting those crops can provide products for personal consumption and sale.

If harvesting from a buffer that is part of a government cost-share program, make sure harvest complies with program regulations.

PLANT SELECTION?

Buffer must include grasses, forbs, shrubs, and trees arranged in manner to meet particular objectives.

Plants can include both wild, native plants, and improved varieties of food- and fodder-producing species.

Improved varieties typically cost more and require more management, but also provide more potential for future revenue from the buffer.

For example (see sketch above):

ZONE 1: native riparian forest trees and shrubs.

ZONE 2: improved varieties of fruit and nut trees and shrubs with non-aggressive ground cover.

ZONE 3: native herbaceous species, pollinator planting, or perennial shrub crop production.

MANAGEMENT PLAN?

- Pre-existing perennial ground cover should be controlled prior to establishment to maximize survival.
- Consider tree tubes and/or fencing to protect trees from wildlife damage
- Consider weed mats, mulch, or planted ground cover to control aggressive vegetation.

FUNDING AND PLANNING ASSISTANCE?

Connect with the local conservation district and extension offices to learn about federal and state cost-share programs such EQIP, CRP, and CSP. These offices can also provide connections with regional consultants and technical service providers.

The Savanna Institute is a 501(c)(3) nonprofit organization working to catalyze the development of and adoption of resilient, scalable agroforestry in the Midwest US. We work in collaboration with farmers and scientists to develop perennial food and fodder crops within multifunctional systems grounded in ecology and inspired by the savanna biome. The Savanna Institute strategically enacts this mission via research, education, and outreach.

SARE Sustainable Agriculture Research & Education

This product was developed with support from the Sustainable Agriculture Research and Education (SARE) program, which is funded by the U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). Any opinions, findings, conclusions or recommendations expressed within do not necessarily reflect the view of the SARE program or the U.S. Department of Agriculture. USDA is an equal opportunity employer.

SAVANNA INSTITUTE

UNDERSTANDING AGROFORESTRY

Silvopasture

The intentional integration of trees, pasture, and livestock, managed as a single system.

BENEFITS

Economic

INCOME STABILITY via diversified production of timber/tree crops, forage, and livestock.

PROFITABILITY: Improved livestock health and production through reduced stress; decreased need for grain for poultry and hogs in forest-based foraging systems.

COMPREHENSIVE LAND UTILIZATION: Provides relatively constant income from livestock sale and selective sale of trees and timber/tree crop products.

Ecological

SHADE AND WIND PROTECTION: Trees offer protection for livestock through shade during summer and wind reduction in the winter.

INTEGRATED MANAGEMENT: Economical control of weeds and brush without pesticides; livestock manure recycles nutrients to trees and forage; tree shade reduces lignin content of forage.

WILDLIFE HABITAT PROVISION: Trees provide structural diversity which increases habitat for birds and wildlife.

CHALLENGES

SUCCESS DEPENDS ON EXPERIENCE AND TIMELY MANAGEMENT. Practitioners must be familiar with the dynamics of managed grazing, forage growth, and tree establishment to time management appropriately and avoid damage.

TRADEOFFS BETWEEN LIVESTOCK AND TREE PRODUCTION: difficult to maximize both at the same time.

LONG TERM COMMITMENT: multi-year commitment and strategy is required to implement.

PUTTING IT INTO PRACTICE

Frequently Asked Questions

WHAT TREES TO PLANT/SELECT FOR?

Depends on management objectives, site conditions, whether converting pasture or forest to silvopasture, and desired products

PASTURE TO SILVOPASTURE: plant trees (timber, fruit and nut producing trees, or fodder trees) and provide tree protection.

TIMBER STAND/WOODLOT TO SILVOPASTURE: thin and/or prune trees to increase ground exposure to light and establish forage that tolerates shading .

WHAT ARE THE BEST FODDER TREE SPECIES?

LEAF FODDER: poplar, willow, mulberry, black locust.

MAST: oak, hickory, chestnut, pecan, walnut, honey locust, apple, and many other fruit/nut trees.

PLANTING ARRANGEMENT

EVEN DISTRIBUTION: optimizes growing space and light for both trees and forage.

CLUSTERS OR ROWS: concentrates shade root effects while providing open space for pasture production.

WHAT LIVESTOCK TO STOCK?

Cattle, pigs, goats, sheep, chickens, turkeys, and more can all be used independently or as part of a multi-species rotational system.

STOCKING RATE AND ROTATION?

Depends on forage and tree characteristics, livestock type, extent of fencing.

IS THIS JUST "GRAZING THE WOODS?"

No. Woodlot grazing has been shown to have negative effects on forest health. Silvopasture involves managing the stocking rate and timing of grazing through rotational grazing within permanent or semi-permanent fencing arrangements.

FUNDING AND PLANNING ASSISTANCE?

Connect with the local conservation district and extension offices to learn about federal and state cost-share programs such EQIP, CRP, and CSP. These offices can also provide connections with regional consultants and technical service providers.

The Savanna Institute is a 501(c)(3) nonprofit organization working to catalyze the development of and adoption of resilient, scalable agroforestry in the Midwest US. We work in collaboration with farmers and scientists to develop perennial food and fodder crops within multifunctional systems grounded in ecology and inspired by the savanna biome. The Savanna Institute strategically enacts this mission via research, education, and outreach.

SARE Sustainable Agriculture Research & Education

This product was developed with support from the Sustainable Agriculture Research and Education (SARE) program, which is funded by the U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). Any opinions, findings, conclusions or recommendations expressed within do not necessarily reflect the view of the SARE program or the U.S. Department of Agriculture. USDA is an equal opportunity employer.