LANDSCAPE CONSERVATION COOPERATIVES

Multi-LCC Mississippi River Basin / Gulf Hypoxia Initiative
High Impact Conservation Practices – Fact Sheets

Suite #5 – Biomass Production

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WHAT IS BIOMASS PRODUCTION?

With increasing concern for US energy independence and the environmental and climate impacts of fossil fuels and petroleum-based products, there is a major push for renewable sources of energy and products. One type of renewable energy can be produced from biomass (i.e., organic matter) through various conversion pathways. Two classes of bioenergy feedstocks are (1) dedicated energy crops and (2) residues from crops grown for other purposes. Among dedicated energy crops, it is possible to distinguish perennial crops (grasses and trees grown in plantations) from annual crops (e.g., energy sorghum, canola, camelina and other oil seed crops). Cellulosic residues harvested from conventional crops (e.g., corn, wheat) and woody residues harvested from forests can also be used to produce alternative fuels (such as ethanol)and direct combustion fuels (often through a pelletization process).

The concept behind biomass production from dedicated energy crops is relatively simple. Instead of growing a traditional cash crop (e.g., corn or soybeans), a producer might instead grow a "crop" of switchgrass or (preferably) some other native mix of warm season grasses. When they mature, these grasses are then harvested (swathed or mowed) and baled. Instead of being used as livestock feed or as a traditional cash/food crop, however, these grasses are then sold to be used in energy production. At its simplest, these grasses can be combusted to provide energy. However, biomass such as grasses can be processed in other ways to produce liquid biofuel such as ethanol, natural gas, or even gasoline/diesel equivalents.

WHY BIOMASS PRODUCTION?

In addition to providing an alternative fuel source, dedicated perennial crops have a variety of environmental benefits. In particular, native grasses can native ecosystems, which in turn provide multiple benefits and ecosystem services. This is especially true if areas of the field

support diverse herbs, forbs, and warm and cool-season grasses. Native warm-season grasses, such as switchgrass, require less input (e.g., fertilizer and pesticides) than conventional crops, thus protecting habitat and reducing growing costs for producers.

Perennial grasses improve groundwater infiltration, water quality, and soil health. Unlike many traditional crops, perennial biofuels provide continuous vegetative surface cover and deep, significant root structures that help to reduce soil erosion and prevent excess run-off that erodes soil and conveys nutrients and pesticides into wetlands and waterways. In addition, perennial biomass crops improve soil health, translocating carbon deeper into soils and increasing soil processes such as nutrient cycling. Even after harvest and as long as a minimal amount of residue from the dedicated biomass crop is left in the field, excess soil and wind erosion can be prevented. Furthermore, when managed appropriately this residue can be used as a feed source for grazing livestock, illustrating the multiple benefits of perennial biomass production.

In addition to these highlighted benefits of biomass production, there may be even larger benefits from growing biomass on lands considered marginal for growing traditional crops. Ultimately, increased water infiltration, decreased fertilizer inputs, healthier soil processes, and decreased soil erosion and nutrient runoff all contribute to the improvement of water quality in downstream waterways. When managed appropriately, biomass production can provide multiple beneficial ecosystem services while also allowing a producer to reduce input costs and still retain the profitability and productivity of his or her land.

WILDLIFE BENEFITS

Aquatic biota in streams and rivers can benefit from converting traditional crops and pasture to perennial native grasses and forbs for bioenergy because sediment and nutrient loading to downstream waterbodies are reduced (Jager et al. 2015). Traditional practices to protect farm ponds and water bodies draining fields (e.g., riparian buffers) are also beneficial. One promising approach is to plant perennial grass and tree buffers around traditional farms and to harvest portions of these as biomass, taking care not to disrupt soil, roots, or use agricultural chemicals. However, the key will be to take clues from the native ecosystem in which the land is located and match vegetation to soil type—this means planting grasses/forbs on prairie soils, trees on woodland/forest soils, and either trees or grasses or both on transitional soils.

One of the primary threats to many species of grassland birds is the loss of essential habitat, often to agricultural production or urban use. These species typically require large contiguous areas of habitat to persist. Growing dedicated perennial biomass crops, like native grasses and forbs suited to the local native ecosystem, in proximity to other grasslands can help to provide or exceed the minimum threshold of habitat needed. In short, where perennial native biomass crops are produced, wildlife can benefit.

In addition, the harvest of biomass crops can be performed in ways that protect wildlife through appropriate timing and spatial patterns of harvest. In particular, USDA CRP lands under the new proposed rule for grasslands will require avoiding harvest during the breeding season for birds, which starts in the spring and ends in the early fall in most places. During harvest, it is recommended that farmers drive in a pattern from the center to the exterior of the field and use beater equipment on harvesters to flush birds and young fawns. After harvest, a minimum of four inch stubble height can help prevent soil and wind erosion and a minimum of ten inches can provide nesting habitat for wildlife. If the whole field cannot be harvested at a ten inch stubble height for economic or other reasons, then at least a portion (particularly buffer zones) of the field could be harvested at that greater height to maintain wildlife benefits.

When managed appropriately, bioenergy-producing lands can provide crucial habitat and cover for wildlife even after harvest. In particular, grasses provide nesting habitat for many species of grassland bird. Similarly, stubble and residue from fall harvest can provide nesting structure for migratory waterfowl in the spring. Rotational or partial (e.g., strip) harvesting will ensure that habitat is provided during all seasons, including winter. Providing multiple benefits for wildlife, water quality, and soil health while simultaneously providing benefits to producers,it is easy to see why biomass production is such an appealing alternative to traditional cash cropping.

INSTALLATION & COSTS

Installation costs and production costs will vary based on factors such as soil conditions and planting techniques. In general, however, a recent study in Nebraska, North Dakota, and South Dakota can grow switchgrass and other biomass plants for a total cost (including labor) of approximately $60/ton. However, this number decreases with experience, with one producer growing switchgrass for $38/ton. Increases in fuel and land prices have likely driven these total costs slightly higher, but overall these numbers illustrate that growing biomass can be economically feasible, at least in the central and southern Great Plains. Alternative markets for biomass, including animal feed and biomaterials, provide a more sustainable and robust economic incentives for bioenergy production.

MONITORING

Joint Ventures have monitoring objectives and strategies in place for a variety of grassland bird species. (UMGLJV, PPJV, LMVJV)

LIMITATIONS/CONSIDERATIONS

While most biomass plants are relatively low maintenance once established, some (especially switchgrass) require some input during the initial one-three year establishment period. This might involve periodic mowing, grazing, or burning. Some spot weed control might also be necessary to protect the developing biomass flora from more aggressive species. Patience is encouraged—it is typical and expected for a native warm-season grass/forb planting to look spotty and weedy in the establishment year and sometimes in the second year of establishment.

While biomass production requires few agricultural chemicals or irrigation, it must still be profitable and productive for the producer. An education/outreach program to increase awareness of the benefits of producing biomass (especially on marginal lands) might be necessary to maximize this practice's utilization. In addition, it may be necessary to defray the costs to the producer in some manner in order to encourage the initial establishment of the biomass crop.

Perennial native biomass crops such as diverse mixtures of native warm season grasses and forbs provide an alternative of use as livestock forage versus biomass for energy. This is advantageous to the agricultural producer because he or she can sell to the market that is most profitable that year (livestock or energy). However, it is very unlikely that economic gain could be had both ways (forage and biomass) in the same year. Native grass residue after biomass harvest is unlikely to be of value as livestock forage for two reasons – first, because the timing of biomass harvest is after the point in which grasses would be palatable to livestock, and second because biomass harvest would push stubble as close to the ground as possible (to maximize biomass for sale) and not much would left for livestock consumption.

RESEARCH, PROGRAMS, AND MORE INFORMATION

USDA Energy Programs: http://www.fsa.usda.gov/programs-and-services/energy-programs/

The Forest Stewardship Council maintains a certification system for sustainable forest management: http://www.fscus.org/

The Council for Sustainable Biomass Production is working to establish a certification program for sustainably grown biomass in North America: http://www.csbp.org/

The international Roundtable on Sustainable Biofuels is developing a certification system for sustainable biofuels: http://cgse.epfl.ch/page65660.html

OPPORTUNITY AREAS

(TBA)

SOURCES

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