USER GUIDE: **Productivity and Economic Assessment Tool for SRWC-Based Feedstock Production in the Southeastern U.S.A.**

For landowners interested in growing short rotation woody crops (SRWCs) on lands with limited use or low fertility for conventional agriculture and forestry, effects of land types on economic returns, and economic implications of stand or management decisions are key considerations. To help address these and other related viability questions, a web-based productivity and economic analysis tool was developed for SRWC-based feedstock production using an enterprise budget for best stand management on marginal lands. Where SRWCs are established, productivity has been robust, nevertheless markets for SRWC-based feedstocks currently in the USA are limited and landowners should first explore if there is a market available in their area for the feedstock.

The aim of this user manual is to make understanding and using the assessment tool straightforward, and to guide users to select site attributes that best characterize their land.

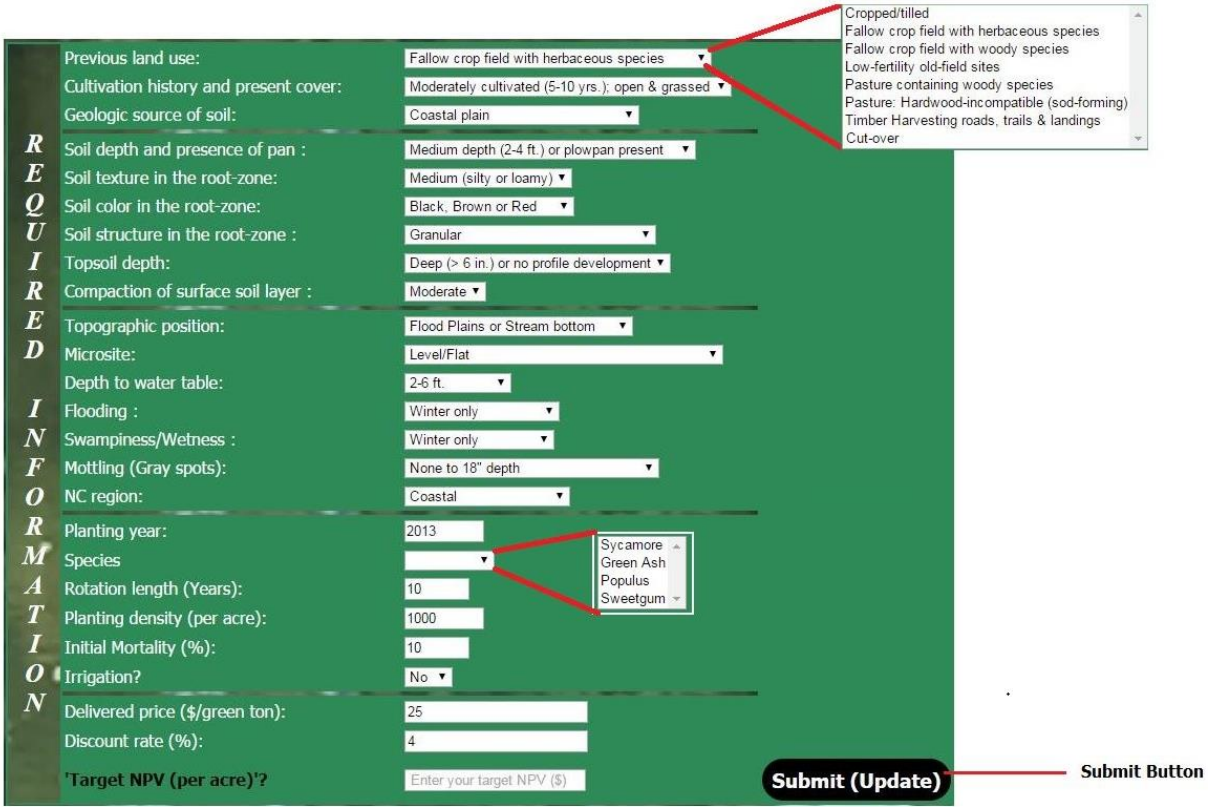
What is the SRWC Feedstock Production Tool? A web-based productivity and economic analysis tool used to evaluate potential of marginal lands in the southeastern USA to produce SRWCs, which are fast-growing trees that can be harvested in a few years and are usually grown for a single purpose such as feedstock for the production of energy or paper. The analysis is based on land history, site conditions, species, economic factors and management decisions that affect productivity and economic returns. The tool employs an enterprise budget that has been developed from our own experiences in growing these trees and published data from others. The tool currently runs on Chrome or Opera browsers.

What is the Tool used for? This tool allows the user to explore the productivity and economic viability of growing SRWCs based on user input. Productivity, project budget and economic returns are determined based on user-provided information. The tool can be used to determine delivered price or productivity required to achieve a target net present value such as a breakeven point.

How is the Tool Run?

(A) Enter required information by selecting the options for each blank cell using the drop-down selections or filling in the blank cell when appropriate using the best information that you have available. Information that you may not have but can obtain may improve reliability of results.

(B) After all required inputs are entered, click the "Submit (Update)" button **twice** to view results.



INPUTS:

Table 1: Required Information (Baker & Broadfoot, 1979; Michler & Rathfon, 2006; Stringer et al., 2009)

Previous land use - refers to type of land or land use prior to the intended use. The options are:

- Cropped/tilled: refers to fields recently under row crops that are subject to perennial weeds before and after the trees are planted.
- Fallow crop field with herbaceous species: fields fallowed for a season, and are subject to competing herbaceous and possibly woody species.
- Fallow crop field with woody species: refers to crop fields that have been fallow for several years on which vines, trees and shrubs are growing.
- Low fertility old-field sites: subject to weeds including cool-season grasses, broomsedge and woody species, and poor soil fertility.
- Pasture containing woody species
- Pasture: Hardwood-incompatible (sod-forming): dominated by sod-forming grasses such as fescue.
- Timber harvesting roads, trails and landings: are subject to poor soil conditions and herbaceous weeds, vines and shrubs.

- Under rotation: refers to timber stands that are considered for regeneration under existing.

Cultivation history and present cover: The intensity of prior cultivation and the current vegetation cover of the land, and dictate the physical land conditions and availability of moisture and nutrients to support tree growth. The options include undisturbed/near-virgin forest or less than 5 years of cultivation, moderately cultivated (5-10 yrs.) or open and grassed, and intensively cultivated (> 10 yrs.) or open and bare.

Geologic source of soil affects the availability of nutrient for plant growth. The options include:

- Mississippi River/Loess/Blackland: Soils that have origins from Mississippi River deposits, wind-deposits or Blacklands.
- Mixed coastal plain & other: Soils with origins including coastal plains and one or more of Blackland or loess or Mississippi river deposits.
- Coastal plain: Soils that originated from coastal plains.

Soil depth and presence of pan: Refers to the depth of soil profile and the presence/absence of a highly compacted subsurface layer formed naturally (inherent pan) or by agricultural practices (plow pan), and affects the physical land condition and moisture availability to grow trees. Options include: deep soil (> 4 ft.) or without pan; medium depth (2-4 ft.) or plowpan present; shallow soil (< 2 ft.) or inherent pan present.

Soil texture in the root-zone (top 18 in. of the soil), which affects the physical conditions of lands and moisture availability to support tree growth. The options are: medium (silty or loamy), coarse (sandy) and fine (clayey).

Soil color in the root-zone has implications on soil aeration. The options are: black, brown or red, yellow or brownish-gray and gray.

Soil structure in the root-zone affects tree growth though its effects on physical land conditions, moisture availability and soil aeration. The options included are granular, prismatic, structureless: sandy (single-grained), massive: clay, massive: loamy or silty, platy and blocky. The texture of the structureless soil options should match the above-selected soil texture option.

Topsoil depth: Depth of A-horizon and has implication on nutrient availability for tree growth. The options are deep (> 6 in.) or no profile development, medium (3-6 in.) and shallow (< 3 inches).

Compaction of surface soil layer (top 1-ft.), which affects the physical conditions of land to grow trees. The options are none, moderate and strong.

Topographic position has implications on availability of moisture for tree growth. The options are: flood plains or stream bottom, stream terraces or lower slopes and upland position.

Microsite refers to unique physical attributes of the land and affects soil moisture availability during growing seasons. The options are: concave/depression (pocket, trough), level/Flat and convex/Ridge (mound).

Depth to water table: Depth of the upper surface of groundwater, a zone of permanent saturation. It affects availability of moisture substantially. The options are: 2-6 ft., 1-2 or 7-10 ft., >10 ft. and <1 ft.

Flooding affects availability of moisture during growing seasons. The options include: none, winter-only winter through spring and continuous flooding.

Swampiness/Wetness affects soil aeration. The options are winter-only, January to July and waterlogged all year.

Mottling (Gray spots) refers to the formation of gray spots in the soil profile due to frequent and extended wetness. The mottling depth affect the soil aeration. The options are none to 18" depth, none to 8" depth, and mottled to surface or gray mineral soil.

Planting year: the year of stand establishment although the project budget includes costs for site preparation during the year preceding the planting year.

Species: Hardwood species including sycamore, green ash, poplars and sweetgum.

Rotation length (years): The period from planting (stand establishment) to harvest. The range for rotation length is 3 to 20 years. Rotation length can be changed to improve outcomes.

Planting density (per acre) is the number of trees planted per acre. The range of possible values that can be selected/entered is 250 – 5000 trees per acre.

Initial Mortality (%) refers to the number of dead trees (per acre) during the planting year divided by the number of trees planted (per acre) expressed as a percentage. The minimum and maximum mortality values are 0 and 50% respectively.

Irrigation? If 'Yes' is selected, irrigation costs and effects on increasing productivity are accounted.

Delivered price ($/green ton): Initial price can be entered using current feedstock prices as a guide and changed to examine effects of the prices considered on returns.

Discount rate (%): should be entered as a percentage.

'Target NPV (per acre)': This input is not required for an initial run. It is applicable when determining the productivity or feedstock delivered prices required to achieve a target net present value (NPV). If no value is entered, a target NPV of zero is assumed and a break-even analysis is performed.

Submit (Update) button is used to obtain results or updates of project budget, productivity and economic returns after all required values (inputs) are entered or one or more inputs are changed.

OUTPUTS:

Table 2: Land Suitability, Productivity and Economic feasibility:

Site quality rating (0-1) is an index of suitability evaluation of a land for growing a particular SRWC species based on land attributes. Values close to one (1) indicated high suitability of the land for a selected species while values close to zero (0) show unsuitability.

Biomass Estimate (Green ton) is the wood biomass of the selected species produced per acre under the selected land (site) attributes. It is determined as a product of the calculated site quality rating and mean annual increment of the species.

RESULTS				
		Site quality rating (0 - 1):	**0.93**	
		Biomass estimate (Green ton):	**62.0 tons / ac = 138.93 tonnes / ha**	
	2012	Total cost during preplanting year	$ 272.00 / ac	13.9% of total project cost
	2013	Total cost during planting year	$ 428.69 / ac	22.0% of total project cost
	2014	Total cost during maintenance year	$ 96.23 / ac	4.9% of total project cost
	2023	Total cost of harvesting & hauling	$ 1153.85 / ac	59.1% of total project cost
		Revenue at delivery	**$ 2169.13 / ac**	
		Net Present Value (NPV)	$ 218.36 / ac	
		Net Future Value (NFV)	$ 323.22 / ac	
		Equivalent Annual Value (EAV)	$ 26.92 / ac	
		Land Expectation Value (LEV)	$ 673.03 / ac	
		Benefit-to-Cost Ratio	1.11	
	Biomass or price required to achieve 'target NPV'	**Green Biomass**	**Delivered Price**	

Cash-flow summary provides the following outputs expressed in today's value of money:

- Total annual costs of the project (rotation)
- Percentage distribution of costs during rotation years (annual total cost divided by total project cost)
- Revenue at delivery

Net present value (NPV, $/ac) is a measure of profitability/loss in today's value of money, calculated as total income at delivery minus total stand costs (preparation, establishment and maintenance, harvesting and hauling). High positive NPVs indicate profitability and negative NPVs mean losses.

Net future value (NFV, $/ac) is a measure of profitability/loss expressed in terms of the value of money at the end of rotation. Negative NFVs indicate losses.

Equivalent annual value (EAV, $/ac) is a measure of annual income from SRWC stands. Negative EAVs indicate equivalent annual losses incurred due to the project.

Land expectation value (LEV, $/ac) shows value of the land used to grow a particular SRWC stand continuously. A high positive LEV shows attractiveness of a project whereas a negative LEV indicates that value of the land with the project in mind is low and economically unfeasible.

Benefit-to-cost ratio is the ratio of total revenue at delivery to the total stand costs during the rotation. A project is profitable if the benefit-to-cost ratio is greater than 1 and economically unfeasible if the ratio is smaller than 1.

Biomass or price required to achieve 'target NPV': 'Target NPV' is an input provided by the user. If no 'Target NPV (per acre)' is provided, a 'target NPV' of 0 (breakeven is assumed).

- Clicking on the "Green Biomass" button gives the green biomass yield (ton/acre) required to achieve the 'target NPV' using the user-provided delivered price.
- Clicking on the "Delivered Price" button gives the price ($/green ton) required to achieve the 'target NPV' using calculated productivity.

Table 3: Project Budget:

The project budget contains annual itemized costs of activities, materials and labor incurred to optimally prepare the land and establish and manage stands based on the land type, and harvest and haul feedstocks. The budget table also outlines applicable activities for successful establishment and management of stands on a particular land.

PROJECT BUDGET

Year	Items	Cost ($/Unit)	Total ($/acre)
2012	Post-emergent Herbicides	5.28/L	9.98
	Pre-emergent Herbicides	11.52/L	0.00
	Pesticide	16.9/L	0.00
	Offset disking & operator	16.5/acre	16.50
	Self-propelled sprayer & operator	3.8/acre	3.80
	Bush hog mowing & operator	31.5/acre	31.50
	Small grain (rye) cover crop	1.7/lb	0.00
	Pernnial grass (redtop) cover	12.95/lb	181.30
	NPK (10-10-10) Fertilizer	417.67/ton	0.00
	Liming	218.18/ton	0.00
	Irrigation Installation & Labor	2470/acre	0.00
	Herbicide/Pesticide application Labor	12.28/hr	0.00
2013	Post-emergent Herbicides	5.28/L	0.00
	Pre-emergent Herbicides	11.52/L	43.55
	Pesticide	16.9/L	0.00
	Offset disking & operator	16.5/acre	0.00
	Self-propelled sprayer & operator	3.8/acre	0.00
	Bush hog mowing & operator	31.5/acre	0.00
	V-ripper subsoiler & operator	18.3/acre	18.30
	Prescribed Fire	16.77/acre	0.00
	Small grain (rye) cover crop	1.7/acre	0.00
	Pernnial (redtop) grass cover	12.95/acre	0.00
	NPK Fertilizer (10-10-10)	417.67/ton	0.00
	Liming	218.18/ton	0.00
	Planting Populus Trees	0.33 /seedling	330.00
	Enrichment Planting	0.33 /seedling	0.00
	Irrigation Maintenance	85/acre	0.00
	Herbicide/Pesticide applicaition Labor	12.28/hr	24.56
	Planting Labor	12.28/hr	12.28
2014	Post-emergent Herbicides	5.28/L	0.00
	Pre-emergent Herbicides	11.52/L	21.77
	Pesticide	16.9/L	16.90
	Bush hog mowing & operator	31.5/acre	31.50
	Enrichment Planting	0.33/seedling	33.00
	Irrigation Maintenance	85/acre	0.00
	Herbicide/Pesticide applicaition Labor	12.28/hr	24.56
2023	Cutting & loading rate	10.74/ton	521.70
	Hauling	0.14/ton	353.63
	Fuel	2.3/gal	29.14

References

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Prepared by: Solomon Ghezehei, Dennis Hazel and Robert Bardon

Department of Forestry & Environmental Resources, NC State University,

Raleigh, NC, 27695, U.S.A.