Optimized Site Selection for Short Rotation Woody Crop Systems in the Lower Mississippi Alluvial Valley.

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Abstract and Introduction

- The advent of the carbon market along with demands for bioenergy has created expanding opportunities for Short Rotation Woody Crop (SRWC) systems.
- In the Lower Mississippi Alluvial Valley (LMAV), opportunities for landowners manifest as afforestation projects for *Populus deltoides* and *Salix nigra* on marginal agricultural sites.
- These pioneer species thrive on alluvial sites and have strong genetic improvement. This makes them the best candidates for SRWC plantations in the region
- This project seeks to develop a spatial process-based 3PG (Physiological Processes Predicting Growth) model for both species and conduct simulations across the LMAV based on a variety of silvicultural and site inputs.
  - Biomass yield from this model will be used to develop an economic analysis to determine the viability of the site for afforestation in the context of pervious agricultural yield.
- **This project seeks to understand the relationship between site, product and regime and if this relationship can be optimized for SRWC systems in the LMAV.**

Methods

- Develop a 3PG model (Landsberg and Waring 1997) for both target species using biomass yield (Dahal et al. 2022) and ecophysiological studies.
- Conduct spatial simulations in r3PG using data (climate and soil) from public repositories.
  - Six simulation scenarios: three different spacing regimes for each species.
- Determine the viability of afforestation by using simulated yield to calculate LEV based on desired product class (pulpwood, bioenergy, and carbon credit) and compare with marginal agricultural site value.
- At the county level, identify optimized afforestation zones (OAZs) based on species, regime, and product combination.

Expected Results and Discussion

- The most limiting factor will likely be the maximum biomass productivity of a particular site.
- Maps showing optimized afforestation sites in the LMAV will be developed.
- A novel black willow 3PG model will be developed.
- Landowners will have better insight about the regime options for afforestation on marginal agricultural sites.

Funding

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Using 3PG Models to Map the Optimization of Site, Product, and Regime Relationships in SRWC Systems.

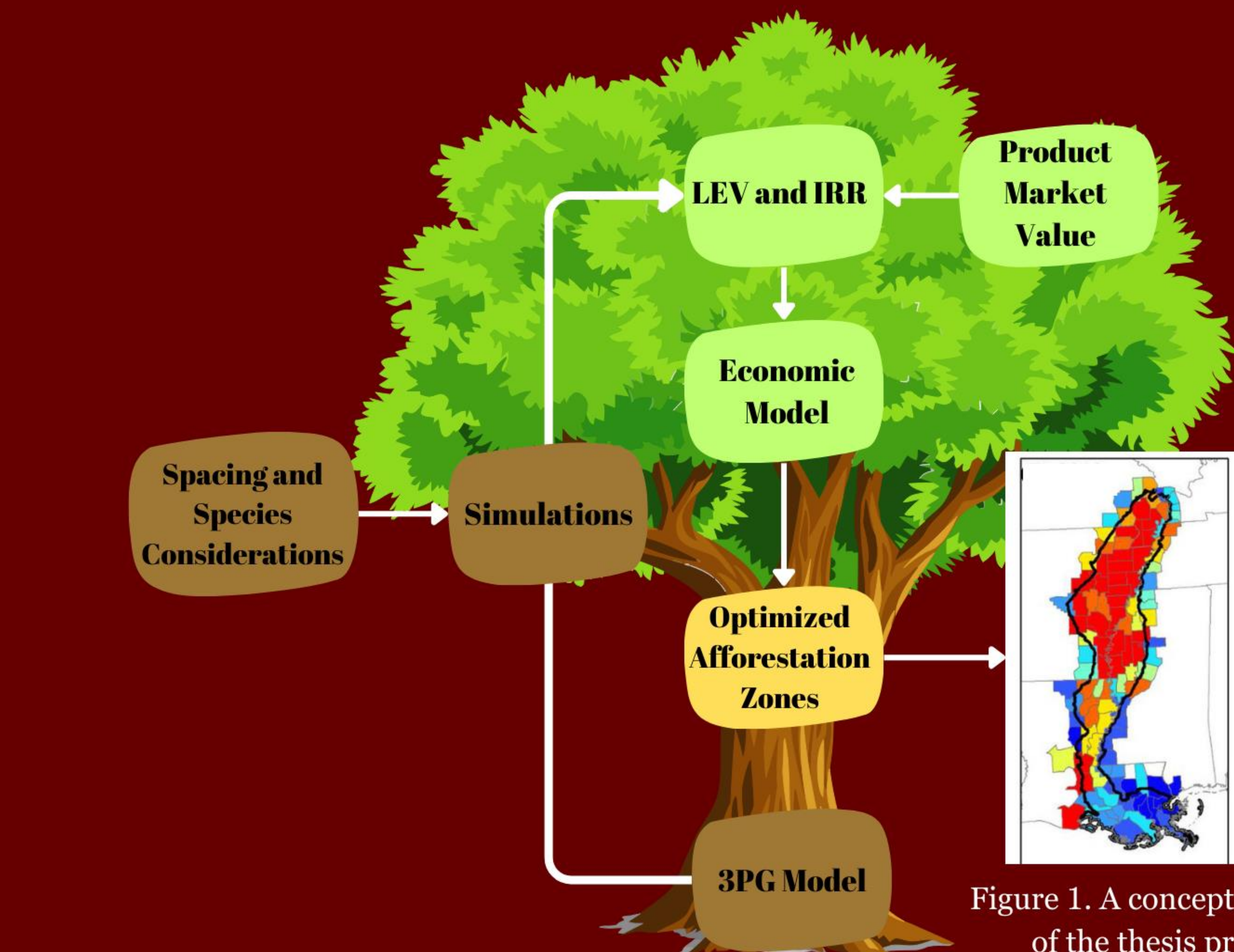
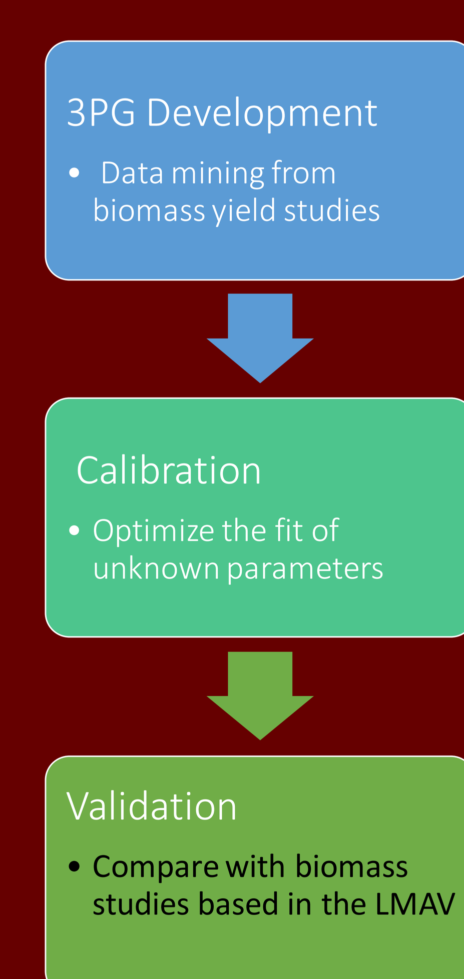


Figure 1. A conceptual model of the thesis project.



$$(1 - f_N) = (1 - f_{N0}) \times (1 - FR)^{n_{fN}}$$

Fertility Rating Equation -Where fn is the portion of actual growth compared to potential growth for a given FR, fN0 is the same proportion when FR = 0, FR is a measure of fertility, and nfN is a species-specific coefficient.

$$\ln H = \ln a_H + n_{HB}(\ln B) + n_{HN}(\ln N)$$

Stem Height Relationship - H is mean tree height, B is mean DBH, and N is trees per unit area. AH, nHB and nHN are species-specific coefficients.

$$\ln V_s = \ln a_v + n_{VB}(\ln B) + n_{VN}(\ln N)$$

Stem Volume Relationship - Vs is mean tree stem volume and av, nVB and nvN are species-specific coefficients.

$$w_{Sx} = w_{Sx1,000}\left(\frac{1,000}{N}\right)^{n_N}$$

Self-Thinning Relationship -Where WSx is maximum tree biomass, N is stand density, Wsx1000 is maximum biomass at 1000 trees per hectare, and nN is the self-thinning slope.

$$p_{FS} = a_p \times B^{n_P}$$

Foliage:Stem Partitioning -Where PFS is foliage/stem ratio and ap and np are species-specific coefficients.

Figure 3. Core 3PG formulas for parameter development, as described in Headlee et al. 2013

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