Risk and Uncertainty at the Farm Level

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Sources of Risk for Agricultural Firms

- **Risk happens when the uncertain outcome of a choice made by a decision maker alters the well-being of that decision maker (Robison and Barry, 1987).**
- **Business risk:**
  - **Production or technical risk,**
  - **Market or price risk,**
  - **Technological risk,**
  - **Legal and social risk, and**
  - **Human sources of risk.**
- **Financial risk.**

Risk and Biomass Crops

- A biomass-based energy industry may have a very different set of business and financial risks than for coal and oil industries.
- Weather may have very large impacts on the quantity and quality of biomass produced for energy production in any one year and on biomass harvest, storage, and transportation decisions.
- Thus, an important aspect of risk for the industry will be with on-farm production of bioenergy crops.

Risk and Biomass Crops

- Switchgrass, a perennial grass that is native to the U.S., may be an important cellulosic feedstock.
- If switchgrass is to be produced as an energy feedstock, it will need to compete with other crop and livestock activities in terms of expected profit and the variability of profit (risk).
- Growth and development characteristics of a perennial such as switchgrass may influence its risk and return tradeoffs with other farming activities.
- Logistics of harvest, storage and transport of switchgrass may also affect risk and return for a producer.

Objective

- To explore some of the potential on-farm business and financial risks that may be associated with producing a dedicated bioenergy crop such as perennial switchgrass.

Outline

- Potential sources of risk.
- Potential risk management benefits.
- Case Study.

Potential Sources of Risk—Establishment (Years 1-3)

- **Switchgrass can be difficult to establish because of**
  - Seed dormancy,
  - Soil moisture and temperature conditions with spring planting, and
  - Weed competition.
- **It takes three years for switchgrass to reach its full yield potential after establishment.**
  - Mooney et al. (2008) reported that first- and second-year switchgrass yields across several landscapes and soil types in an experiment at Milan, TN, averaged 14- and 60-percent of third-year yields.

Potential Sources of Risk—Establishment (Years 1-3)

- Farmers may be reluctant to grow switchgrass because of the upfront establishment costs and the delay in the uncertain revenue stream.
- Producers who have contracts shorter than the lifespan of the stand may find themselves holding an asset that does not have value if the contract is not renewed.
- Because the stand is a durable asset, it may be subject to technological risk in that newer, higher yielding varieties may be developed.
- Because switchgrass is a perennial that may be under contract for a number of years and requires less inputs after establishment, landowners may opt to manage the switchgrass themselves.
  - Rising rents may potentially increase costs for farmers.
  - Producers unable to rent as much land as they are accustomed to may not be able to spread their fixed costs over as large a crop area.

Potential Sources of Risk—Harvest & Storage

- Projected harvesting time for switchgrass is once in the fall after a killing freeze (Rinehart, 2006).
- The coarse and fibrous switchgrass harvested after a killing freeze may increase repair and maintenance costs of equipment and reduce the lifespan of equipment compared with other forage-type materials.
- With the large amount of biomass to be harvested, machine and labor time per unit of crop area may increase at an increasing rate for each additional ton harvested, thus machinery and labor costs will likely be higher for switchgrass (Cundiff, 1996).
- Higher precipitation fall and winter months may limit field days and increase harvest times and biomass losses relative to other potential harvest periods (Hwang and Epplin, 2007).

Potential Sources of Risk—Harvest & Storage

- **Once-a-year harvest and substantial area to store production will likely require storage of a substantial amount of biomass away from the plant on the farm.**
  - **Precipitation and weathering may affect the quality and dry matter losses of switchgrass bales and thus the yield of ethanol (Wiselogel et al., 1996; Sanderson et al., 1997).**
  - **The weight of bales transported to the bio-refinery may be influenced by exposure to precipitation while being stored on the farm.**
    - **In a study by English et al. (2008), uncovered round bales after 100 days showed 5”-10” of weathering along the bale’s outer edge, and bale weights increased an average of 117 lbs/bale.**
    - **Uncovered on-farm storage may increase transportation costs to the bio-refinery.**

Potential Sources of Risk—Harvest & Storage

- Given the potential for weathering, a processor may require that stored bales be protected from precipitation and weathering.
- Large numbers of switchgrass bales under storage may be a fire hazard and present liability issues for the farmer.
- Who pays for the on-farm protection and storage of the crop—the farmer or the bio-refinery?

Potential Risk Management Benefits After Establishment

- Switchgrass is more drought resistant than other crops (Bransby et al., 1989) and may provide higher yields than many annual crops in drought years.
- In wet springs when planting of annual crops may be difficult or impossible, switchgrass may reduce the probability of a crop failure due to weather because it is only planted once every 10 or more years.
- Switchgrass may tolerate very wet conditions during the growing season better than many annual crops and may provide higher yields.
- Switchgrass requires less pesticides, and fertilizers than most crops currently grown in the U.S.

Case Study

- **Risk Management Scenarios:**
  - **No Biomass Crop Assistance Payments (BCAP, 2008 Farm Bill).**
  - **BCAP Planting Payment:**
    - **75% of establishment costs during the first year.**
  - **BCAP Harvest Payment:**
    - **Cost-share payments up to $45 per dry ton for the harvest, storage, and transport of biomass crops to user facilities.**
  - **BCAP Planting and Harvest Payment:**
    - **Combination of both payments.**

Case Study

- **Yields, production costs and net revenues for two contrasting agricultural soils in Tennessee were used for the evaluation.**
  - **Loring soil type:**
    - **Common agricultural soil found in West Tennessee.**
    - **Crops typically gown include corn, cotton, soybeans and wheat.**
    - **Moderately well drained with slopes ranging from 0 to 20 percent.**
  - **Dandridge soil type:**
    - **Typically found in East Tennessee.**
    - **Agricultural uses include pasture and hay for beef cow-calf production.**
    - **Shallow, excessively drained, and have slopes ranging from 2 to 70 percent.**

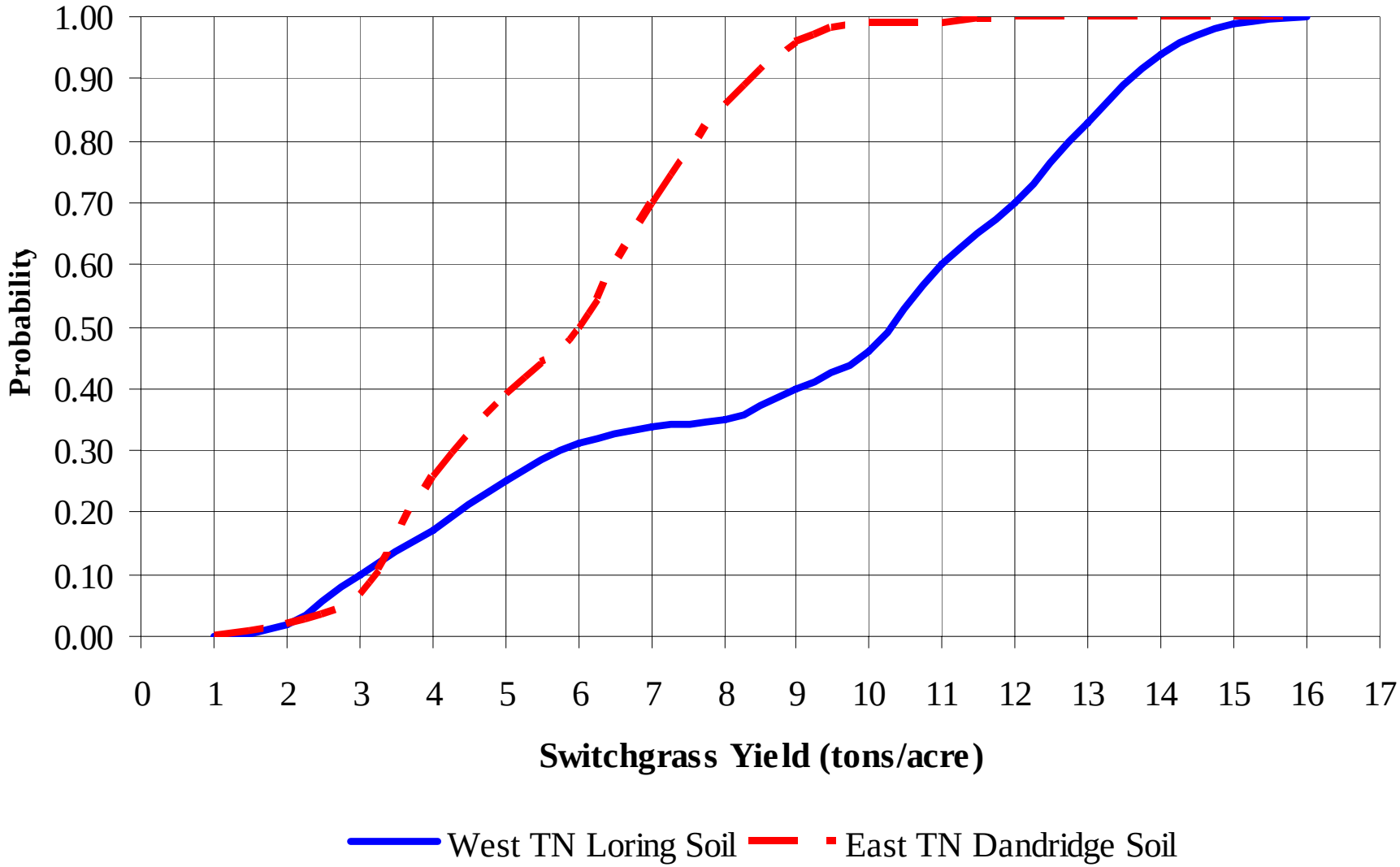
Net Revenue Simulation

- **100 years of switchgrass yields were simulated for each soil type using ALMANAC and 100 years of daily weather data.**
- **100 years of switchgrass, fertilizer nitrogen, and diesel fuel prices for each crop alternative were simulated using @RISK:**
  - **Price data for estimating the nitrogen fertilizer and diesel fuel distribution parameters were obtained using 1977 through 2005 prices reported in *Agricultural Statistics* (USDA-NASS, 1977 through 2007 Annual Issues).**
  - **Net energy-equivalent to wholesale gasoline biomass prices (accounts for energy to convert to ethanol) for 1977-2005 were used to calculate prices and distribution parameters for @RISK Wang et al., 1999; U.S. DOE, 2007).**
  - **Prices were inflated to 2006 dollars by the Implicit Gross Domestic Product Price Deflator (U.S. Congress, Council of Economic Advisors, 2007).**

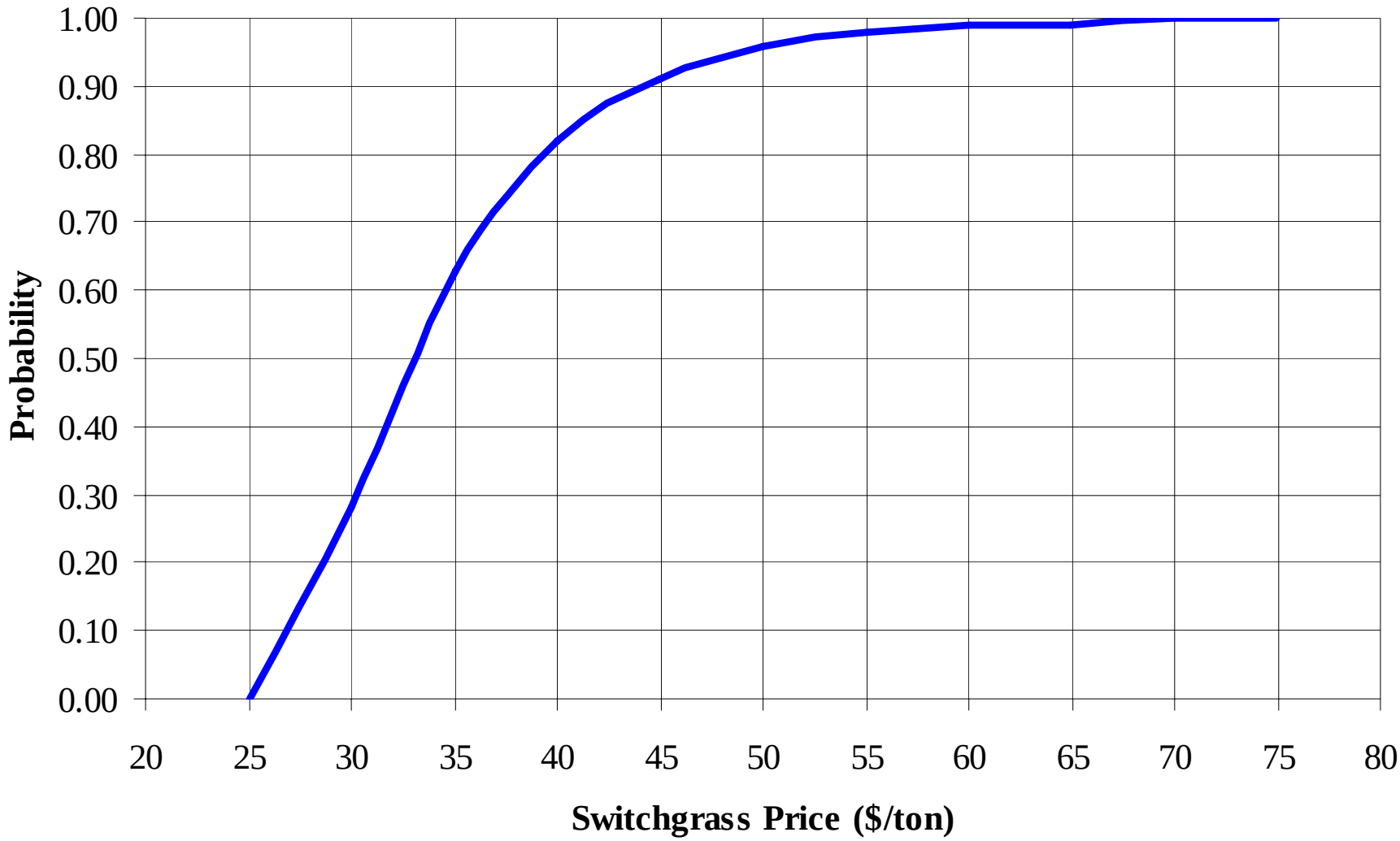
Net Revenue Simulation

- **Production costs from modified Tennessee Extension budget for switchgrass (Gerloff,2007):**
  - Machine time for the baling and handling operations were assumed to be a function of yield.
  - Capacity of the large round baler was assumed to be 5 bales per hour (i.e., one hour of machine time with a five ton yield).
  - Bale handling operations were assumed to operate at a rate of 5 bales per hour.

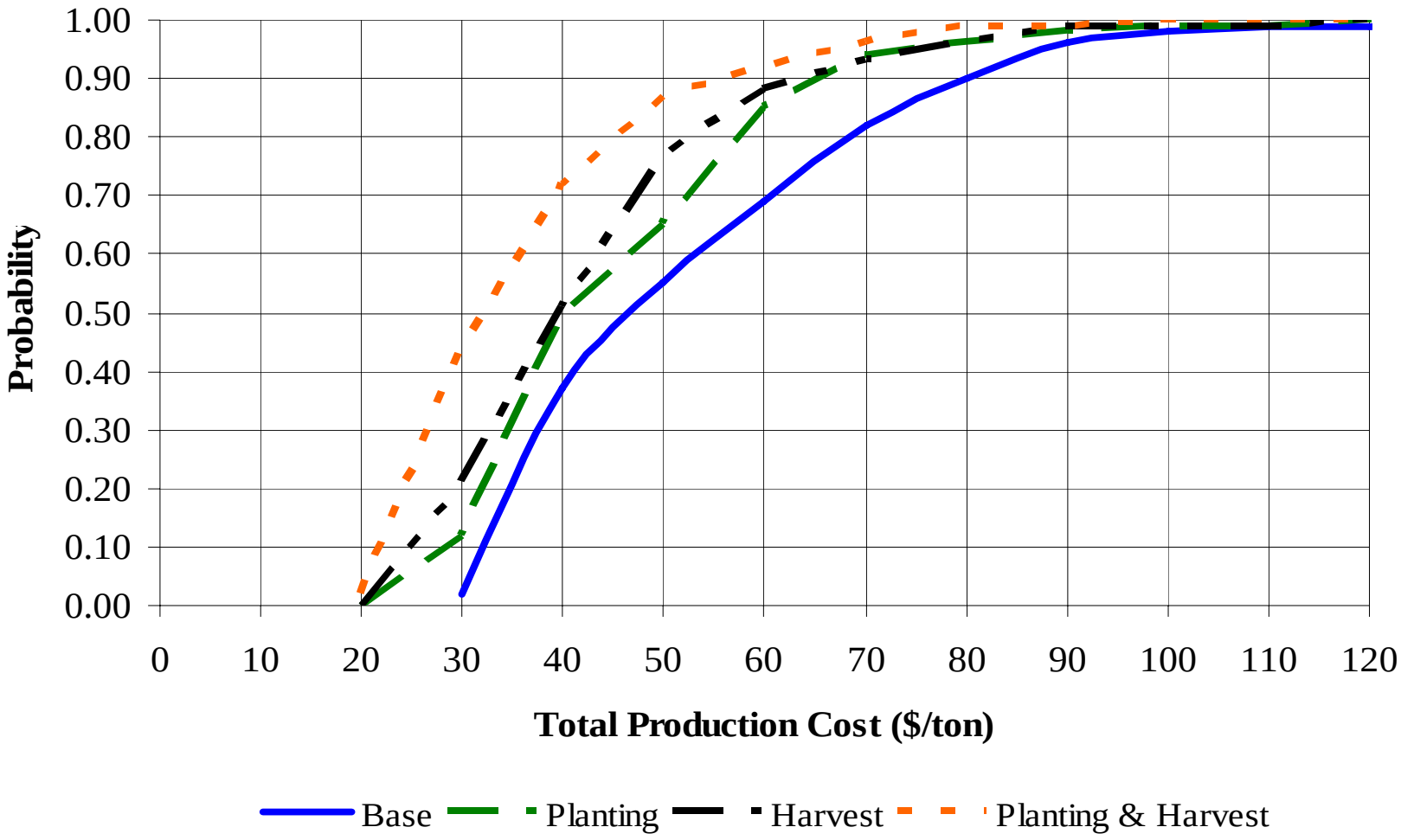
Switchgrass Yield Distributions



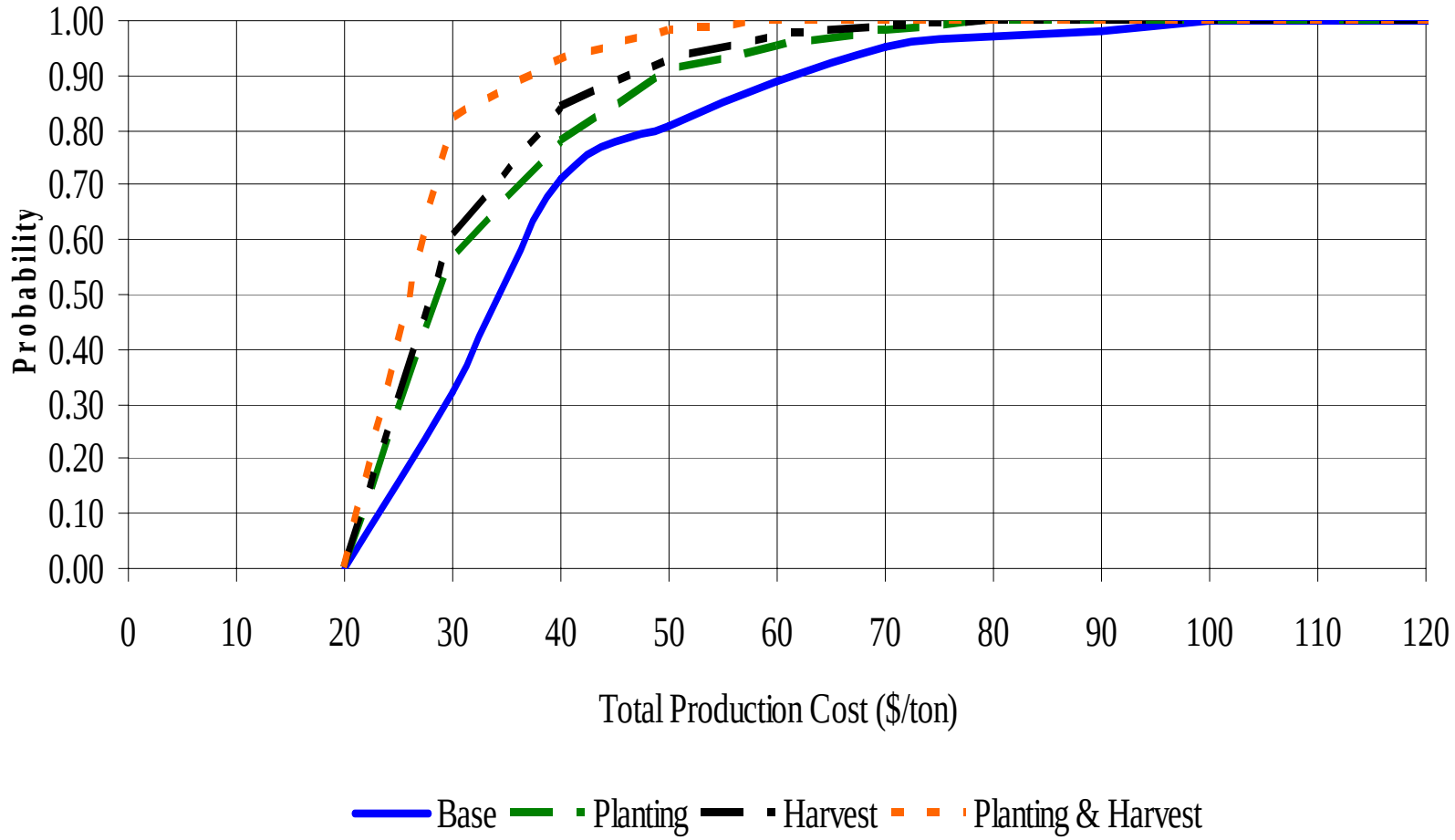
Switchgrass Price Distribution



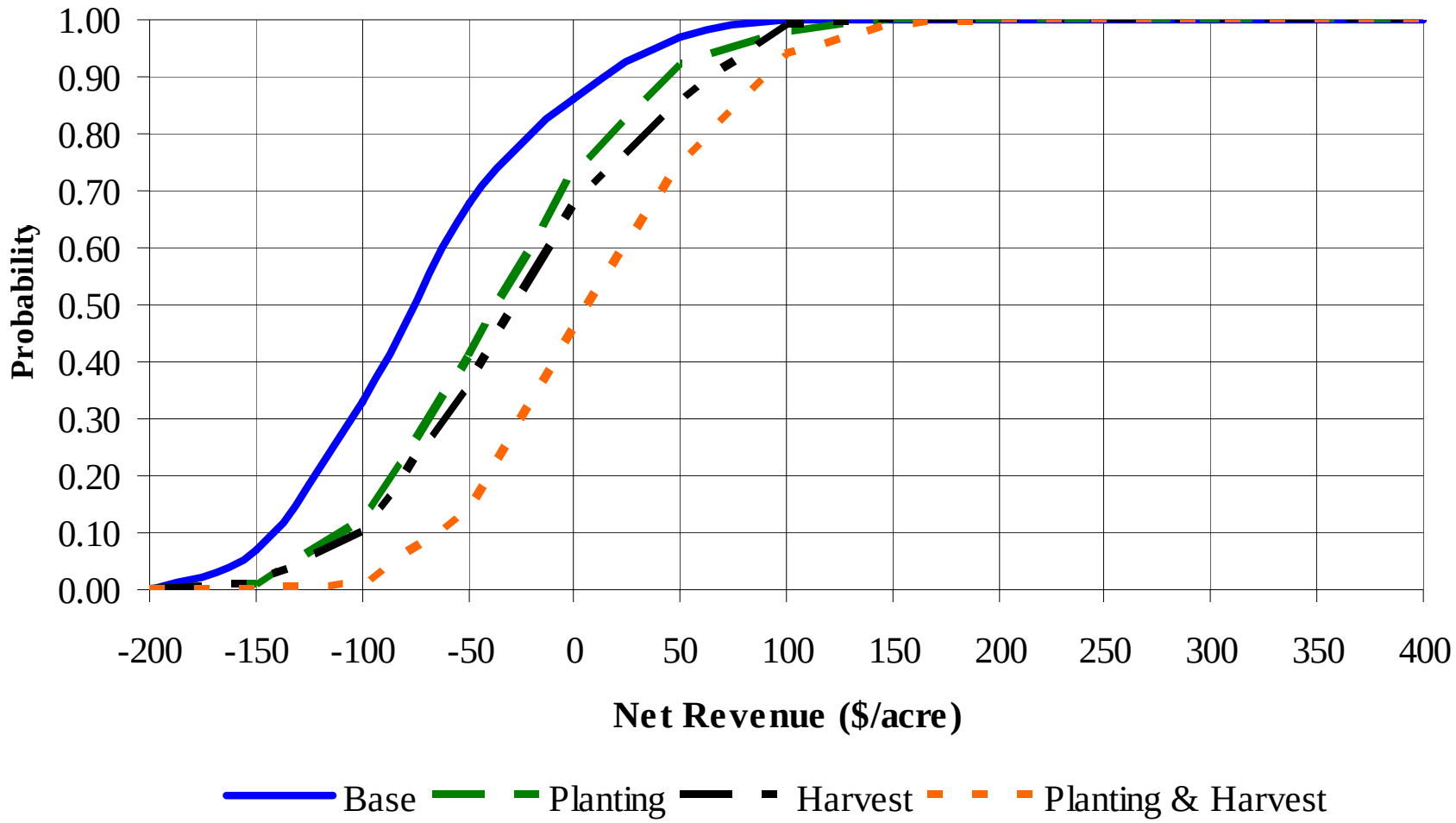
Switchgrass Production Cost Distribution—East TN Dandridge Soil



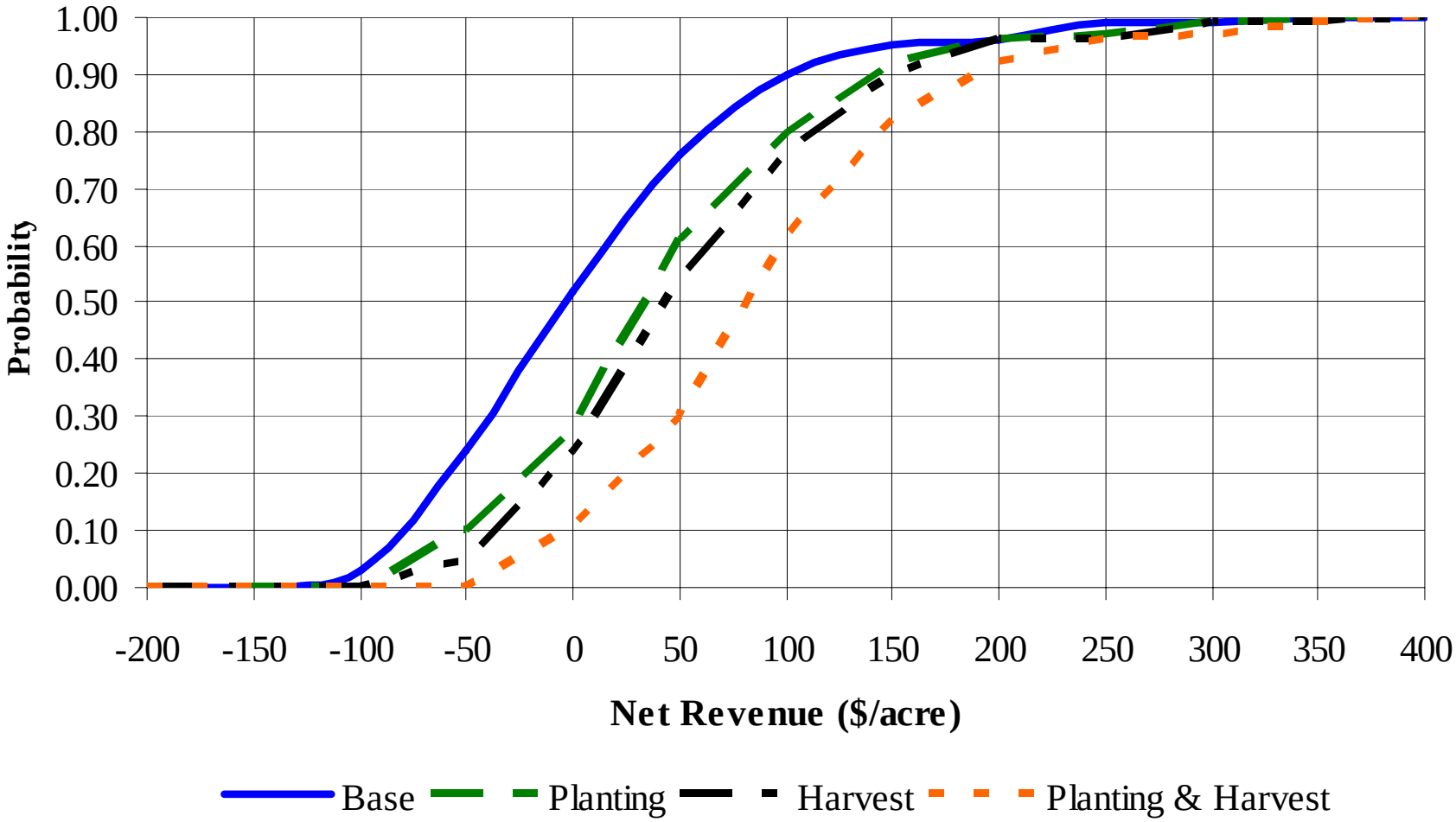
Switchgrass Production Cost Distribution—West TN Loring Soil



Switchgrass Net Revenue Distribution—East TN Dandridge Soil



Switchgrass Net Revenue Distribution—West TN Loring Soil



Summary and Conclusions

- **Potential on-farm risk management challenges with switchgrass production:**
  - **Difficulties in establishing the stand and low yields the first three years after establishment.**
  - **Weather effects on the harvest, storage, and transportation of feedstocks.**
- **More research is needed on how the emerging industry of interrelated feedstock producers, bio-refineries, and auxiliary service providers, such as transportation and storage, will be structured and how each will bear and/or share business and financial risks.**