

# Economics of Agroforestry

2013 Agroforestry Academy









*“ . . . a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually to eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to its healthy functioning. It assumes, falsely, I think, that the economic parts of the biotic clock will function without the uneconomic parts.”*

Aldo Leopold



# What is Economics?

- Economics is the study of “Choice”
- We must choose between scarce resources and unlimited wants
- Because of scarcity, choices require trade-offs

# Economics vs. Finance

- Economics is the study of how people and society allocate and distribute scarce resources
- Finance is one tool for measuring the value of the trade-offs made
  - The focus of finance is the time value of money
  - Money often represents, or actualizes, the trade-offs made by individuals and society.

# Preferences and Trade-offs

- Most of economics can be summed up in four words: “people respond to incentives”.
- An incentive is simply an opportunity to trade something of value for something of higher value.
- Trade-offs are made between resource uses of low “value” and resource uses of higher “value” based on individual preference.

# How are Preferences Determined

- Culture
- Beliefs
- Social Norms
- Personal Knowledge



# Benefits and Costs

- Every choice we make impacts our ability to reach our objectives and reflects our preferences.
- Those things that help us reach our objectives are called benefits (high value).
- Those things that are traded for those benefits are called costs (lesser value)
- The first step is to identify what is being traded

# Economic Trade-off Objectives

- Financial Objectives
  - Wealth
  - Possessions
  - Income
- Environmental Objectives
  - Clean water
  - Clean Air
  - Biodiversity
- Social Objectives
  - Leisure
  - Status
  - Health

# Possible Agroforestry Economic Benefits

- Financial Benefits
  - Niche market revenue
  - Conservation payments
  - Timber markets
  - Tax incentives
- Environmental Benefits
  - Reduced erosion
  - Increased soil fertility
  - Increased Biodiversity
- Social Benefits
  - Improved aesthetics
  - Connection with the environment



*“Just because I can do it, doesn’t mean I will do it.”*

Larry D. Godsey

# Rational Individuals

- One of the basic assumptions in economics is that all individuals behave “rationally”.
- A simple example best defines “rational” for economists:
  - If an individual prefers A over B, and B over C, then that person is rational if they prefer A over C

# Socioeconomic Constraints to Agroforestry Adoption at the Farm level

- Long period of time for trees to payoff
- Labor shortages
- Land shortages
- Financial constraints
- Incompatible with some forms of fixed capital assets
- Insecure land/tree tenure
- Risk
- Lack of knowledge by farmers
- Tragedy of the Commons



# Bounded Rationality

- Another assumption of economics is that an individual is only able to consider a limited set of potential trade-offs at a single time.
- This concept is called “Bounded Rationality”, meaning the individual acts rationally, based on the limited number of options they are aware of.

# Simultaneous Diversity of Outputs

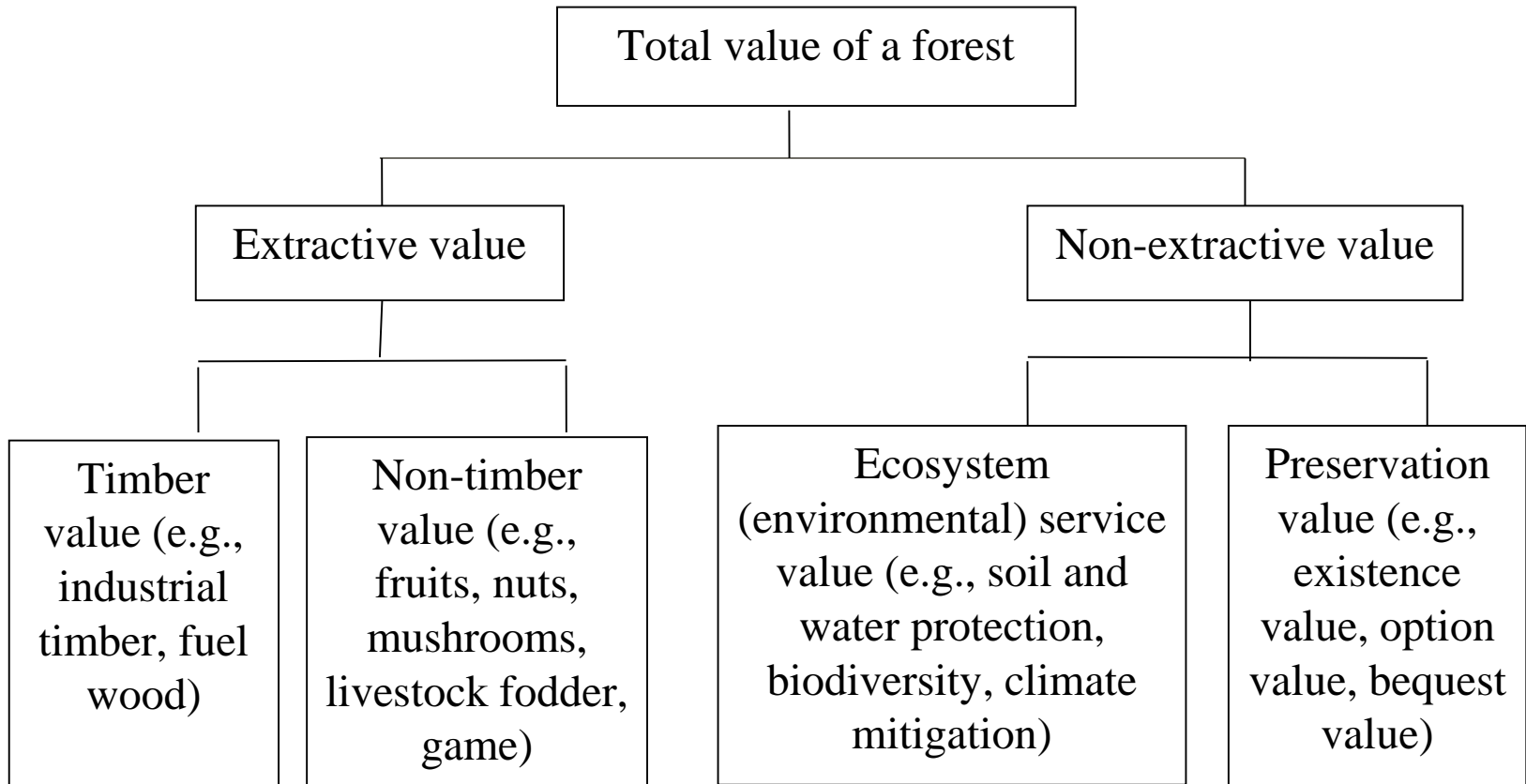
- Some outputs can be traded in the market (priced)
- Other outputs are non-market benefits (unpriced)
- Economics deals first and foremost with monetary values (market or monetary values)
  - Does benefit = value?
  - Does “Price” as a monetary value exhaust the concept of value?

# Three Types of Value

- Value in Exchange
  - Market price (monetary value)
- Value in Use
- Intrinsic Value
  - Option Value – the value of knowing that you could benefit if you wanted to
  - Bequest Value – the value of knowing that future generations could benefit if they wanted to
  - Preservation Value (Existence Value) – The value of knowing that something exists (i.e. the Amazon rain forest)



**Figure 1.1: A forest's economic value**



# Time as an Input

- Forest products are impacted by “biological lag”
- In agroforestry analysis, time becomes a factor of production.
- Economic decisions must be made that reflect trade-offs between various inputs and time (i.e. should we apply fertilizer to speed up growth, thus increasing cost)

# Challenges of Agroforestry Economic Analysis

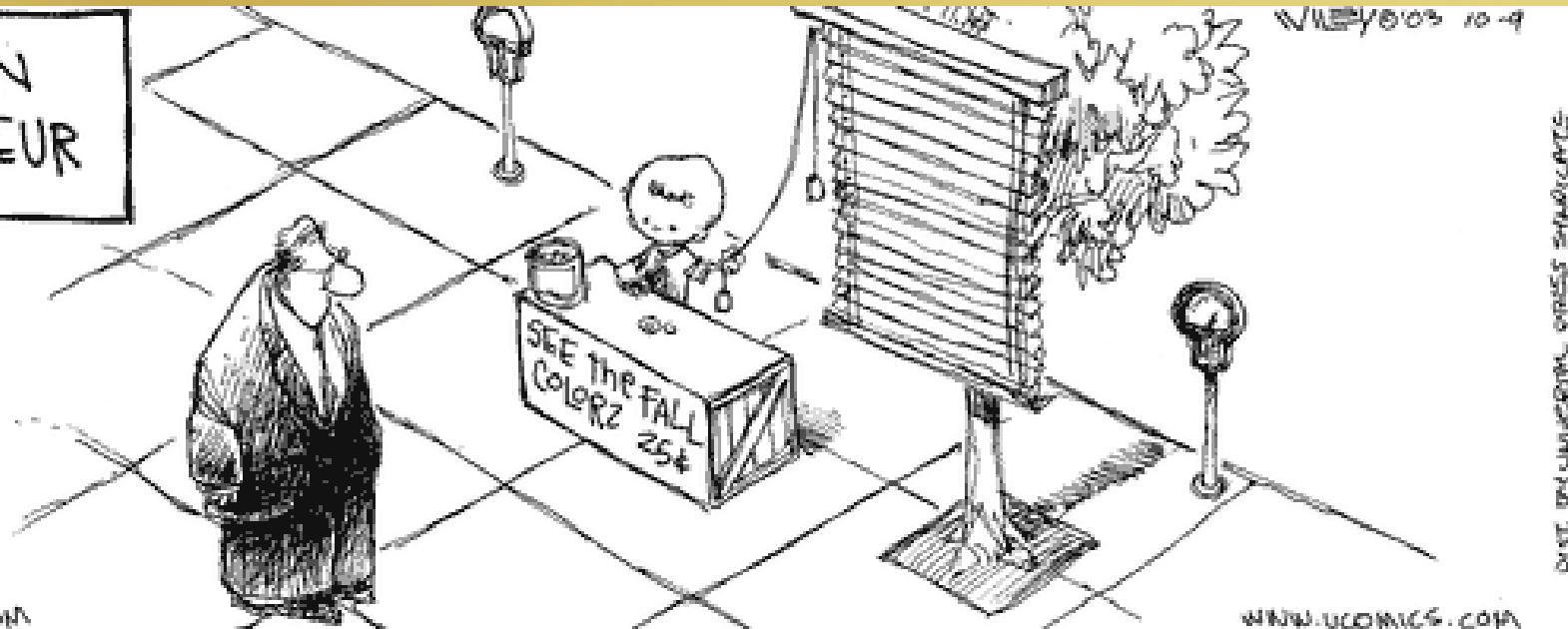
- Lack of markets and market information
- Biophysical science is still identifying the benefits
- Ecosystem services are often regarded as rights not goods
- Government intervention impacts choice
- Decision makers don't fully understand the impacts of their choices

# Lack of Markets and Market Information

- Niche markets often experience more price variability and risk.
- Some benefits from agroforestry practices are not priced or sold:
  - Technical (non-rivalrous, non-excludable)
  - Political (Illegal products)



# The URBAN ENTREPRENEUR



# Government Intervention

- Direct Impacts: Government policy (the Farm Bill) often provides incentives and disincentives regarding agroforestry.
- Indirect Impacts: Government policy (Financial Lending requirements) often establishes barriers that make agroforestry adoption more difficult than traditional farming practices to finance.

# Other Considerations

- Intermediate products
  - “The value of fishing is not in the fish, but in the experience of catching a fish”
  - For many landowners, the pleasure of owning and maintaining trees is an unpriced benefit that is valued more than the revenue received from selling products from the trees.

# Benefit/Cost Analysis

- Compares the Benefits(Revenues) to the costs to attain those benefits using financial analysis tools.
- B/C analysis is often biased against agroforestry practices
  - Cannot take into account unpriced benefits
  - Cost are easily priced



# Cost Considerations

- Two broad areas of costs:
  - Fixed (costs that would be incurred regardless of productive activity)
  - Variable (costs associated with production)
- Four main categories of Variable Costs:
  1. Establishment – site prep, planting, etc.
  2. Management – fertilization, pest control, etc.
  3. Harvesting – mechanized, manual
  4. Marketing – advertising, transportation, etc.

# Labor

- Often labor is omitted from the analysis of costs.
  - Landowners don't know how to price their time or the time of family members
- Farm labor is becoming more scarce (farm sector unemployment is near 2%)

*“The Lazy man is the most efficient”*

D. Matthew Hartwig, Owner, Red Cross Pharmacies INC.

# Opportunity Cost

- “The value of the next best alternative”
- The “highest and best use” of a resource is based on the fact that opportunity cost is minimized.
- Opportunity Cost must be considered:
  - Land (rent), Labor (wages), Capital (interest), Entrepreneurial resources (profit)



# Entrepreneurship

- The difference between an entrepreneur and labor:
  - Entrepreneur - takes risk and is rewarded with profit (normal profit and excess profit)
  - Labor - takes little risk and is paid a competitive wage.
- Today's farmers can hardly be considered entrepreneurs

# The Shut-Down Rule

- If Average Variable Costs are greater than Average Revenues than you should stop what you are doing.

# Criteria for Investment Decisions (Benefit/Cost Analysis)

Criteria 1: Positive net benefit – Net present value is greater than or equal to 0

Criteria 2: Benefit/Cost Ratio – if B/C ratio is greater than 1, then every dollar of investment (C) is earning more than a dollar of return.

Criteria 3: Internal Rate of Return- Calculates the interest rate that equates  $PV_{\text{revenues}} - PV_{\text{costs}}$  to zero

Criteria 4: Payback Period – Calculates that time where the rate of return is 0

# UMCA Decision Support Models

BWDST V1.1.1.xls [Compatibility Mode] - Microsoft Excel

## Eastern Black Walnut Decision Support Tool

Version 1.0

### Establishment Decisions:

Site Prep:

Spacing (Ft):  x

Layout/Design:

Site Index:  (Average tree height in feet 50 years after planting)

Planting Stock:

Fertilization:

Tree Staking:

### Harvesting and Marketing Decisions:

Harvest Method:

Percent Nutmeat:

Nutmeat Grade:

Hulling Method:

Drying Method:

Distance to Market:  enter a distance in miles to the nearest buying station

Expected Rate of Return:  enter a percentage return for this investment

### Management Decisions:

Thinning:  Enter a % of trees removed (i.e. 50%, 33%)

Fertilization:

Pruning:

Weed Control:

Pest Control:

Disease Control:

Deer Control:

### Financial Results

Based on the information that was entered in the model, this Black Walnut Orchard will have the following financial performance over a 70 year period:

Initial Number of Trees/ac	61.7
Expected Price/lb for nuts	\$ 0.70
PV of Revenues @ 3%	\$20,565.55
PV of Costs @ 3%	\$10,727.52
NPV @ 3%	\$9,838.03
Rate of Return (MIRR)	6%
Years to Break Even	13
AEV @ 3%	\$337.80

If you want to use a mechanized harvester, you must have at least 0.93 acres.

You must harvest the nuts within a 216.06 mile radius from the market.

Management Input Cost Budgets Financial Analysis Input Tables Recommendations Chemical costs Nut Price



# UMCA Decision Support Models

- Combine Growth and Yield prediction models with financial decision models designed for landowner or decision makers.
- Instantly show the impact of establishment, management, or harvesting/marketing decisions on the financial performance of the plantation.

# UMCA Decision Support Models (cont.)

- Inputs:
  - Cost estimates (Fixed and Variable Costs)
  - Income estimates (typically on a per acre basis)
  - Yield predictions
  - Establishment parameters
    - Spacing, planting stock, fertilization,
  - Growth parameters
    - Site index, mortality
  - Management parameters
    - Fertilization, thinning, spacing, bd ft value
  - Harvesting and Marketing parameters

# UMCA Decision Support Models (cont.)

- Outputs
  - Net Present Value
  - Modified Internal Rate of Return
  - Annual Equivalent Value
  - Years to Break Even (Payback Period)

# Applications

- Assist with Establishment, Management, Harvesting, and Marketing Decisions
- Cashflow Analysis and Enterprise Budgets for Business planning and lending purposes

# Current models

- Black Walnut Decision Support Model
- Black Walnut Financial Model
- Chestnut Decision Support Model
- Loblolly Pine Decision Support Model
- Elderberry Decision Support Model
- Windbreak Economic Model
- Pecan (forthcoming)
- Biomass (forthcoming)



# Model Gaps (Needs)

- Growth equations
- Yield estimates over time
- Fertilization Impact equations
- Improved cultivar growth and yield data
- Impacts of competition on growth and yield

# Tax Incentives

- Property Taxes:
  - Forest land is taxed at the lowest property tax rate in Missouri.
- Income taxes:
  - Section 194 – Reforestation Amortization and Deduction
  - Section 175 – Conservation deduction
  - Section 126 – Cost Share Payment Exclusion

# Questions?

