Agricultural Production and Technological Change

Advanced Producer Theory and Analysis: The Production of Perennials II

Alexandra E. Hill

AREC 705: Week 2

Colorado State University

Working Paper Overview

Working Paper.

Contributions – what question(s) is the paper addressing? –

Category – theoretical? empirical? case study? meta-study? –

Conclusions – what are the results? –

Context – what are related papers? who are the authors? –

Methods – what methods are used to analyze the problem? –

Working Paper Questions

General thoughts on the paper? –

What do you think about the framing of the paper? –

Thoughts on presentation of theory? –

Are there limitations to (or inaccuracies in) the conceptual framework? –

Are there trade-offs to this model vs. NPV? –

Can you think of any simple ways to adapt the model? –

Maximum Sustained Yield vs. NPV

To vulgarize and oversimplify, there has been a tradition in forestry management which claims that the goal of good policy is to have sustained forest yield, or even "maximum sustained yield" somehow defined. And, typically, economists have questioned this dogma.

(Samuelson 1976)

Maximum Sustained Yield vs. NPV

This apparent clash between economists and foresters is not an isolated one. Biological experts in the field of fisheries are sometimes stunned when they meet economists who question their tacit axiom that the stock of fish in each bank of the ocean ought to be kept as a goal at some maximum sustained level. Similarly, hard-boiled economists are greeted with incredulity if and when they opine that it may be optimal to grow crops in the arid plain states only until the time when the top soil there has blown away to its final resting place in the ears and teeth of Chicago pedestrians.

(Samuelson 1976)

Maximum Sustained Yield vs. NPV

Everybody loves a tree and hates a businessman. Perhaps this is as it should be, and perhaps after the profession of economics is 1,000 rather than 200 years old, the human race will be as conditioned to abhor economists as it has become to abhor snakes.

(Samuelson 1976)

Back to the working paper...

Consider a processing facility of a given size that is supplied a feedstock grown by a perennial crop in surrounding fields...

The manager's problem is:

$$\min \left[\begin{array}{c} \text{farm gate} \\ \text{feedstock costs} \end{array} + \begin{array}{c} \text{Feedstock} \\ \text{delivery costs} \end{array} + \begin{array}{c} \text{Processing} \\ \text{costs} \end{array} \right] \text{ such that } \begin{array}{c} \text{Feedstock} \\ \text{production} \end{array} = \begin{array}{c} \text{Facility} \\ \text{capacity} \end{array}$$

Perennial Production: Age-yield

Production Q is the product of area planted L and per-unit productivity y, so that

$$Q = yL$$

Where y depends on the age-yield function $f(a)$ and the maximum/replacement age n.

$f(a)$ has the following properties:

$f(a)$ is continuous

$f(0) = 0$

$f(a)$ monotonically increases to a maximum, then monotonically decreases

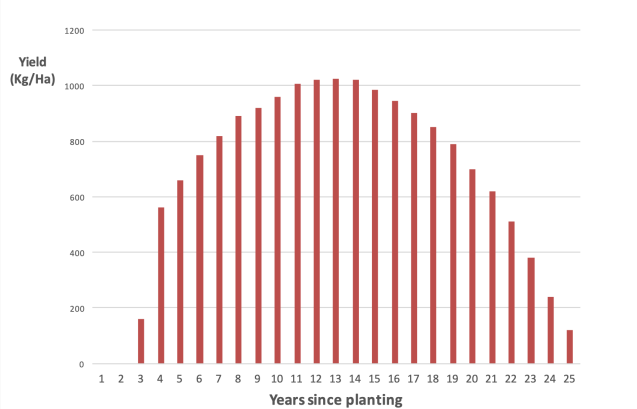
$\lim_{a \to \infty} af(a) = 0$

Perennial Production - Age-yield

In what cases is this MSY strategy reasonable?

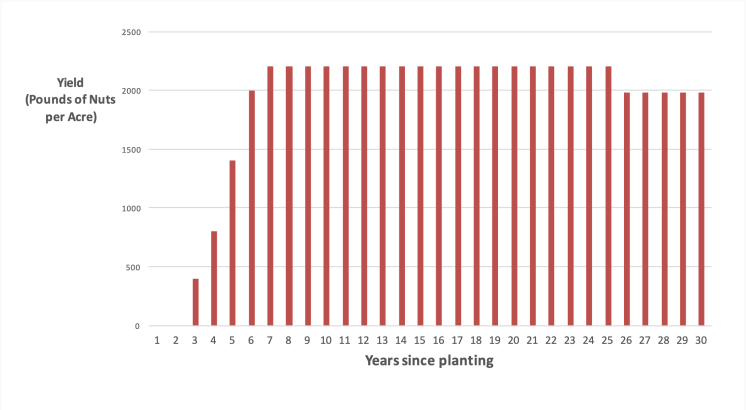
Are these assumptions realistic?

Cocoa in Ghana



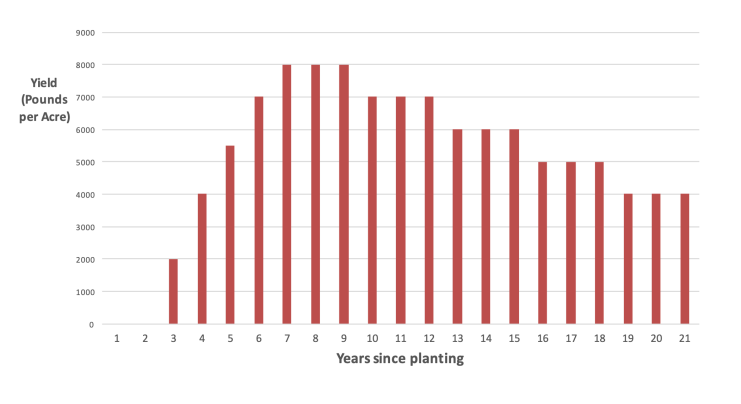
Mahrizal, Nalley, L. L., Dixon, B. L., & Popp, J. S. (2014). An optimal phased replanting approach for cocoa trees with application to Ghana. *Agricultural Economics, 45(3)*:291302. Source: Tregeagle & Simon (2018)

Almonds in California



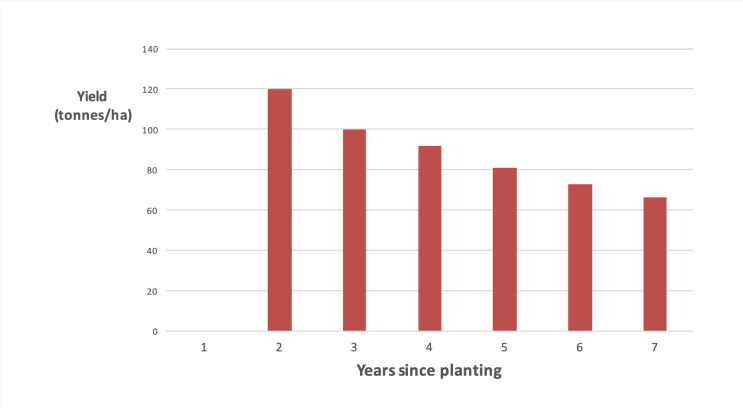
Klonsky, K., Livingston, P., & Tumber, K. (2016). Tree Loss Value Calculator - Almonds, Sacramento Valley. Source: Tregeagle & Simon (2018)

Blueberries in North Carolina



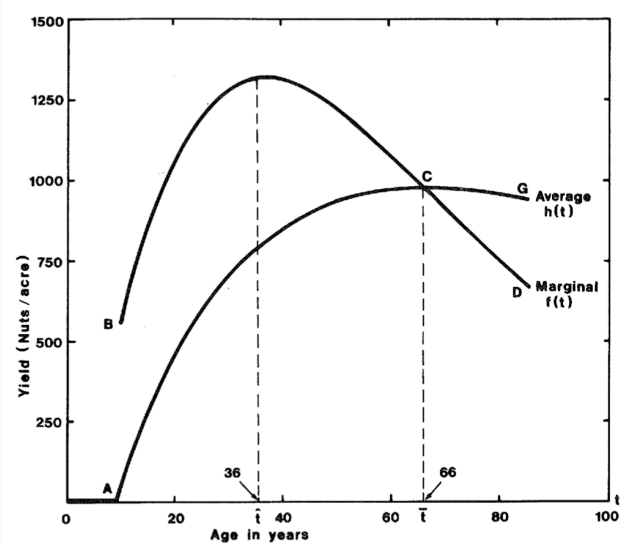
Safley, C.D., Cline, W.O., & Mainland, C.M. (2006). Evaluating the Profitability of Blueberry Production. Source: Tregeagle & Simon (2018)

Sugarcane in Brazil



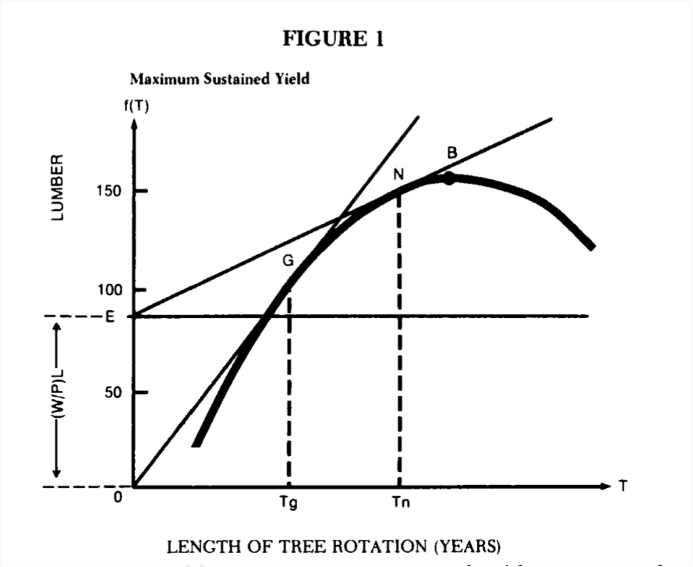
Margarido, F. B. and Santos, F. (2012). Sugarcane Bioenergy, Sugar and Ethanol Technology and Prospects, Source: Tregeagle & Simon (2018)

Coconuts in Sri Lanka

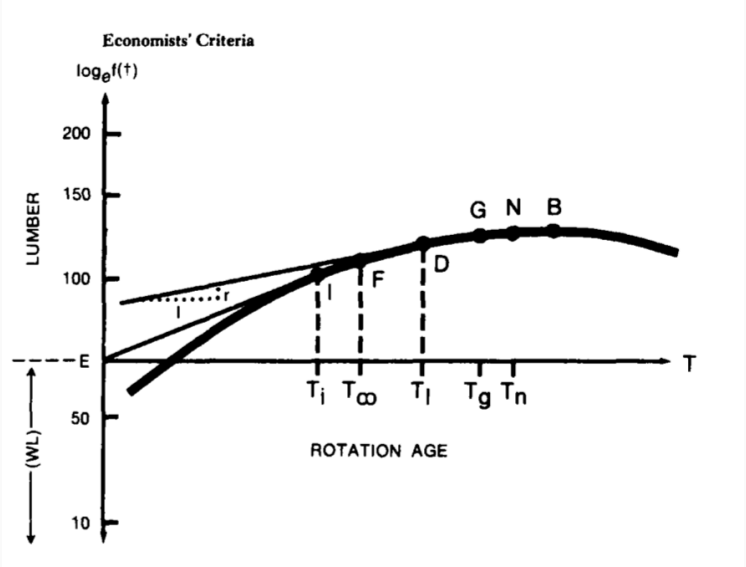


Tisdell, C.A. & De Silva, N.T.M.H. (1986).

Optimal Production from MSY: Samuelson (1976)



Optimal Production from NPV: Samuelson (1976)



Perennial Production - Land-yield

Yields per-unit of land y are estimated assuming a 'balanced orchard' – an equal proportion of land allocated to each age-class.

$$y(n) = \frac{1}{n} \int_0^n f(a)da$$

How would this work with 3-age classes?

Why use the 'balanced orchard'? What does this accomplish?

Maximum Sustained Yield vs. NPV

This pattern... avoids any variability in supply because the replacement pattern is such that the age profile of the crop on the available land never changes.

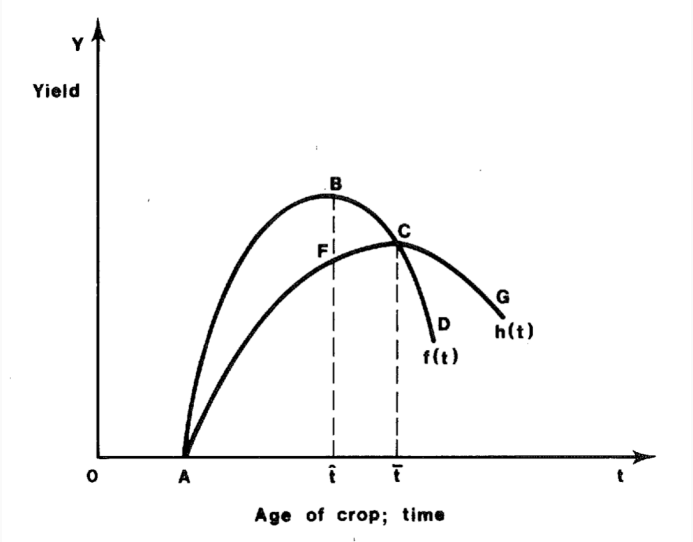
(Tisdell & De Silva 1986)

Maximum Sustained Yield vs. NPV

> *This pattern... avoids any variability in supply because the replacement pattern is such that the age profile of the crop on the available land never changes.*
>
> *(Tisdell & De Silva 1986)*

In other words...
this is the variance-minimizing and yield-maximizing orchard management solution.

Optimal Production from MSY: Tisdell & De Silva (1986)



Perennial Production - Estimating Age- and Land-yield

$$f(a) = ??$$

$$y(n) = \frac{1}{n} \int_0^n f(a)da$$

How can we estimate these functions with data?

What data would we need?

Can we include control variables?