Natural Resource Economics: Considering the Time Element of Investments.

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Introduction: Just as all organisms have a normal life cycle from birth to maturity, all agricultural production systems have a normal economic cycle from initial investment to saleable products. This economic cycle generally follows the life cycles of the plants and animals involved, ranging from 1 year for annual crops, 1-3 years for common livestock, and 10-80 years for timber trees. The normal economic cycle of sheep, for example, is about one year from breeding to sale of the lamb for meat, while cattle have about a 2 year cycle. Fruit trees often require 3-5 years to begin producing significant quantities of saleable fruit after planting and may not reach full production for 5-7 years. While very fast growing timber trees such as hybrid poplar may be profitably harvested within 10-12 years, slower growing trees such as Ponderosa pine or walnut, may not reach commercial size for over 20 years after planting, and may not reach their economic optimum harvest size for over 60 years.

Cash Flow: Short-cycle components such as annual crops or livestock are attractive because they generate income within a year or two of the initial investment. This is very handy if one has taxes, living expenses, or other cash needs to meet. The short investment cycle also facilitates decision making and reduces risk because you do not have to predict events very far into the future and have the flexibility to quickly response to changing circumstances. Longer-term investments, such as trees, tend to both have poor cash flow and higher risk. Their tendency to require substantial initial investment without any income for long periods while trees initially grow is unattractive to many landowners. The relatively high income that can potentially be achieved from an established tree orchard or timber stand, however, is very tempting. Agroforestry, which combines trees with crops/livestock, allows land owners to have immediate income while waiting for trees to begin producing saleable products. This opportunity is obvious to farmers and ranchers. It is not unusual to see farmers that are converting cropland into orchards continuing to grow their usual crops between the trees when the young trees are small, or ranchers that have recently planted trees into pastures continuing to graze or to cut hay from those fields. Agroforestry brings to these spontaneous practices, a formal set of design principles that can be used to improve the efficiency of production and to extend the period of intercropping. For Example, black walnut trees for nuts or veneer logs in the U.S. Midwest Corn Belt are easily

Figure 1. A Farmer in New Mexico continues to grow cotton between pecan tree rows and corn within rows while young trees do use all of the field resources.

grown with the usual corn/soybean rotation when trees are very small. As trees get larger, switching to winter wheat reduces competition between crops and trees, benefiting the yield of each component. Later, as trees canopies begin to substantially shade the crop, pasture may be grown more successfully than grain crops because leaf production is often less sensitive to shade than is flowering and seed production.

Determining Profitability: The profitability of lone-term investments such as trees is tricky to calculate because it depends upon the time-value of money. We can easily accept that money in hand now is worth more than a promise of the same amount of money in the future. First, we may not get promptly paid in the future as promised, and second, any money we get now can be invested and begin to grow. So, if we can get 5% APR (Annual Percentage Rate) interest on money, we would have to get 5% more next year and 10.25% more the following year for us to have the same benefit from a delayed payment as being paid now. This ability of money to generate income in an alternative investment is called its "***opportunity cost***". In our example, the money can be put into the bank at 5% APR interest, so its opportunity cost relative to accepting a delayed payment is 5%. If one applies this time-dimension to growing trees, a stand of trees that cost $500/acre to plant/tend and that sells for $10,000/acre twenty years later does not give a profit of $9,500/acre. If you borrowed the initial $500 at 7% APR, you would have paid $1435 in interest. So, our actual profit was really $8,065 after 20 years, which averages about $403 per year. In addition, you must consider the possibility that the buying power of your initial $500 may have declined over the 20 years due to inflation. After 20 years of 4% annual inflation, it takes $2.19 to buy as much as $1 did when you invested in the trees. So, the $10,000 will only buy as much as $4,566 did when you invested. The way we try to take both the cost of money and the possibility of inflation into account in long-term investments is to adjust our final "profits" using a "***discount rate***". Similar to calculating interest, the rate of growth of our investment can be calculated as a simple compound rate of return that credits income and investments as they occur. This rate is called the "***internal rate of return***". In order to compare investments with different maturities (lengths), it is useful to assess their value as if they were bought or sold today. To do this, we calculate its **"net present value".** This is how much you could afford to pay for the investment today and just break even on the investment when it matures. Most computer spreadsheets will do these calculations once you have entered the income, expenses, and the discount rate. Obviously, the internal rate of return and net present value of an investment are related. The internal rate of return is the discount rate that makes the net present value of the investment zero. That is, considering the timing of each event, the income and outflows of the investment balance over its life time.

Figure 2. Income from growing hay between ponderosa pine trees is especially valuable because it comes early in time.

Sensitivity of Agroforestry Investments: The timing of income and investments is very important in determining their effective contribution to costs and profits. Because agroforestry combines long-term and short-term investments, it is less sensitive to interest rates and inflation than are pure horticultural or forestry systems. It is, however, much more sensitive to the cost of

money than are livestock production or field crops. The income from crops and livestock in agroforestry are especially important because they occur early in the life of the system, and they provide a source of cash that can be used to help finance it. Likewise, savings in costs due to service functions such as weed control by livestock become magnified over time. A $150/acre savings by controlling brush with livestock rather than herbicides during the first 5 years after planting is the equivalent of about $800/acre 25 years later if the cost of money is 7%/year. The normal spread between interest charged by lenders and that received for cash deposited in financial institutions is about 3%. This 3% "savings" on the cost of money can really expand with time, especially with the high investments required for horticultural trees. Self-financing agroforestry system establishment costs greatly improves the profitability of the operation. It can be also be very important for timber lands where revenue received when a former stand is harvested is used to replant the next generation of trees. In states, such as Oregon, where forestry practices laws require all harvested lands be regenerated, the full investment in the next stand is sometimes credited as a cost of harvest rather than being charged against the future stand, so the cost of money to establish the stand is zero. This difference in finance cost partially explains why agroforestry systems are much more attractive to farmers and other land managers who are attempting to afforest land (grow the first stand of trees) than it is to foresters who are predominately reforesting land (growing a subsequent stand after harvest).

Figure 3. Grazing sheep among young pine trees in western Oregon, USA helps control weeds and reduces competition between grass and trees.

Additional Resources:

For Net Present Value:
http://www.investopedia.com/calculator/NetPresentValue.aspx
http://www.finaid.org/loans/npv.phtml
http://office.microsoft.com/en-us/excel/HP052091991033.aspx
For Internal Rate of Return
http://www.valuebasedmanagement.net/methods_irr.html
ftp://ftp-fc.sc.egov.usda.gov/GLTI/technical/publications/economic-simple.pdf