ALABAMA COOPERATIVE Extension SYSTEM

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ALABAMA A&M AND AUBURN UNIVERSITIES

Environmental Partial Budgeting: A Framework For Decision Making

Landowners across the country face major changes in farm and forestry and management practices to help conserve natural resources and protect the environment. Government policies and regulations, as they relate to land ownership—be it farmland or forest—are becoming increasingly strict. Environmental issues and policies will increasingly impact the financial viability and survivability of agriculture. The decisions farmers and foresters make about environmentally related production practices will affect the profitability and the sustainability of their operations for years to come.

In evaluating the benefits and costs of environmental amenities, conventional cost-benefit analysis is usually difficult, and the results can be less than satisfactory. The analysis usually shows that the farmer bears all the costs, and any benefits will be either enjoyed by someone else or will occur at some time in the far distant future. Also, the costs will be incurred in dollars, while most benefits may be non-monetary and hard to value; for example, benefits may be aesthetic or recreational. But, a management tool is available to decision makers that can help them weigh these non-monetary costs and returns.

Partial budgeting is a technique that has long been used in business and agriculture to assess the likely effects of changes in a production system or process. **In partial budgeting, only the changes in the system are evaluated, relieving the manager of the complicated process of evaluating a change in the whole operation.** In partial budgeting, two columns of figures are generated. One column is the sum of "added costs" and "reduced returns." Another column is the sum of "reduced costs" and "added returns." If the sum of the second column is greater than that of the first, the prospective change would be beneficial to the operation.

In making decisions about environmental impacts of agriculture, whether it be to adopt conservation tillage versus grassed waterways for crop production or to incinerate or compost dead broilers, managers can use Environmental Partial Budgeting (EPB) to evaluate the change. For example, an EPB for a farmer thinking of changing from incineration to composting dead birds is given in Table 1.

In this example, both the monetary and environmental advantages of the composter seem to outweigh the advantages of the incinerator. In fact, composting mortality has become one of the most popular disposal methods among Alabama broiler growers. The experiences of one producer in the Tennessee Valley region of Alabama who recently installed a composter is typical of many.

Roland Williams Farm

Problem: Potential For Groundwater Contamination

Roland Williams owns and operates two large broiler houses in DeKalb County near Rainesville, Alabama. The farm is located in a rural area with adequate access to pasture for disposal of broiler waste. But, even though the farm is in a rural area, the entire Sand Mountain area is prone to groundwater pollution. Livestock farming operations and widespread use of septic tank sewage systems, coupled with a fractured limestone bedrock, lead to a high potential for nitrate leaching into groundwater. Farmers in the area are being strongly encouraged to use modern waste-disposal practices to reduce the chance of nitrate contamination of local wells and drinking supplies.

Mr. Williams has been farming full time for several years, and he operates a "family farm" in the best sense of the word. The broiler houses are modern, up-to-date facilities in full operation continuously, except during clean-out. The farm has a well-established fescue pasture. The cattle are fenced away from the pond that collects all the rainwater runoff from the farm; constructed watering facilities are also provided. Used broiler

Table 1. Environmental Partial Budget: Annual Costs Of Composting Versus Incineration For Broiler Mortality, Per 50,000 Bird Capacity, 1.5 Lb. Average.

Added Costs:		**Reduced Costs:**	
Additional Labor	$12.00	LP Fuel	$27.00
Diesel Fuel	5.00	Repairs	5.00
Repairs to Loader	3.00	Fixed Costs	1.50
Fixed Costs	2.50		
Reduced Returns:		**Added Returns:**	
		Feed value	1.00
		Fertilizer value	5.00
Column Total	**$22.50**	**Column Total**	**$39.50**
Environmental Costs:		**Environmental Benefits:**	
1. Requires disposal of more litter.		1. Uses less petroleum fuels.	
2. Requires more space.		2. Makes less air pollution / CO_2.	
3. Has fly/odor problem?		3. Produces valuable by-product.	
4. Requires more management.			

litter is spread on this pasture, with careful calibration to insure that only just enough nutrients are available for the fescue, and no excess is left to leach into groundwater or run off into streams. Until it is ready to be spread, used litter is stored in a clean, modern, dry-storage facility.

Solution

A dead-bird composter, as part of the dry-storage facility, was recently considered for the farm, under guidance from the Tennessee Valley Authority (TVA) Innovative Technology in Agriculture Project.[1]

As shown in the EPB above in Table 1, the composter is an environmentally cost-effective alternative for mortality disposal. A composter was constructed on the Williams farm with cost-share assistance from the Innovative Technology in Agriculture Project. An LP gas incinerator is also available on the farm to dispose of dead chickens. Before the composter was installed, Mr. Williams indicated that he would probably incinerate the smaller dead birds and only compost larger ones. However, now that he has had some experience using the composter, he feels more confident composting smaller birds, as well. He has verified that not only does the composter provide significant cost advantages, but also that composting is more environmentally friendly. He is very pleased with the operation of his composter.

Other types of environmentally oriented waste disposal decisions can be aided by use of the EPB approach, and some of these technologies have also been demonstrated by the Innovative Technology in Agriculture Project.

Dale Baker Farm

Problem: Surface Water Runoff

In the 1980s the scenic Bear Creek Floatway was closed as a result of potentially harmful levels of bacteria in the water. Numerous homes and farms along the waterway contributed to the pollution, and a project was initiated to reduce emissions from these non-point sources (NPS).

The 265-acre Dale Baker farm is located in south Franklin County, Alabama, in the Bear Creek watershed. Mr. Baker is primarily a livestock producer but raises some feed-grains, using no-till methods. The land in this area is highly erodible, with a large proportion of hilly land.

Solution

The farm operation centers around two enterprises: hog production (feeder pigs) and dairy stockers. Mr. Baker faced the need to drastically cut NPS emissions from livestock production into Bear Creek. Many options were available, but the partial budget approach was used to evaluate changing from a pasture-based system of feeder pig production to a modern confinement system. The EPB analysis for this decision was similar to the one in Table 2.

Again, both the monetary and environmental advantages seemed to favor the same option: constructing the confinement facilities. In fact, these

[1]The Environmental Partial Budgeting and the subsequent adoption of innovative technologies given as examples were made with the assistance of a demonstration project jointly sponsored by the Tennessee Valley Authority, the Alabama Cooperative Extension Service, and the United States Department of Agriculture, Soil Conservation Service. The purpose of the Innovative Technology in Agriculture Project was to demonstrate to farmers that the technology to profitably operate in an environmentally responsible manner is available. A second purpose was to demonstrate to non-farmers across the state that the agricultural community is concerned about the wise use of our natural resources and is interested in the wise husbandry of our land.

Table 2. Partial Budget For Annual Costs And Returns For 30 Sow Feeder Pig Production Unit: Pasture System Versus Partial Confinement.

Added Costs:		**Reduced Costs:**	
Building & equipment annual expenses	$2,917.00	Labor savings	$500.00
Waste disposal lagoon annual expenses	583.00		
Additional feed	225.00		
Reduced Returns:		**Added Returns:**	
None.		Pigs/litter.	
		Farrowings/year.	
		Reduced death loss:	$3,800.00
Column Total	**$3,725.00**	**Column Total**	**$4,300.00**
Environmental Costs:		**Environmental Benefits:**	
1. Requires lagoon system.		1. Less runoff/pollution.	
2. Wastes are concentrated.		2. Less pressure on pastures.	
3. Fly/odor problem?		3. Wastes can be better utilized as nutrients.	
4. Requires more management.			

facilities were constructed with cost-share assistance through the Innovative Technology in Agriculture Project.

Other decisions may not be so clear. Problems can arise when the economic incentives and environmental qualities lean in different directions. One such decision was recently faced by Gerald Hilley, who farms near Boaz, Alabama.

Gerald Hilley Farms

Mr. Hilley operates two farms in Marshall County, Alabama, in the northeast section of the state. The main operation is near Boaz, and the other farm is near Arab. Mr. Hilley has two large, caged-layer houses on the Boaz farm, complete with a modern egg-processing facility on the site. The Arab farm has a single house with an egg washer and packer. The farms are about 40 miles apart.

Both farms are located in densely populated areas, so Mr. Hilley has been concerned about the environmental impacts of his operations for some time. He works hard to meet the expectations of his neighbors regarding odors, flies, and lagoon management. But, in spite of these problems, which add considerable overhead and expense to the operation, Mr. Hilley retains a healthy and optimistic outlook regarding the future of his farm. He realizes that concerns of neighbors must be dealt with even in cases where he knows that the problems do not emanate from his farm.

Problem: Rapid Lagoon Fill Up

The Hilley farm near Boaz faced a waste-disposal dilemma. Solids in the flush water from the houses were clogging the lagoon system, causing the lagoons to need pumping out frequently, with the solids and sludge spread on nearby cropland. This operation resulted in excessive down-time and considerable expense. However, without the solids, the lagoon was seen as a sound way to handle the organic wastes from the operation.

Solution

A possible solution was a concrete-lined settling basin. Flush water would pass through the settling basin on the way to the lagoon system. Solids would tend to remain in the settling basin where, because of its construction and design, they would be periodically collected and applied to cropland quickly at a relatively low cost. Organics would continue to the lagoon to be digested. The system was designed to require clean-out of the lagoon semi-annually instead of bi-annually.

A partial budget constructed to evaluate this decision could be as shown in Table 3.

In this case, where the economic and social (environmental) cost of a lagoon overflow accident may be very high, the farmer felt justified in making the decision to invest in the settling basin.

Mr. Hilley says that the settling basin does its job well, but that some additional refinements are needed. He has had several problems. He continues to use the system, although not at peak efficiency. Problems with the system include the following:

• Solids are deposited rapidly in the settling basin but require 10 to 14 days to dry sufficiently for removal, during which time solids are delivered to the lagoon.

Table 3. Environmental Partial Budget For Costs And Returns For A Settling Basin And A Three-Stage Lagoon Waste Disposal System.

Added Costs:		**Reduced Costs:**	
Building & equipment annual expenses	$1,400.00	Labor savings	$500.00
Solids disposal expenses	600.00		
Reduced Returns:		**Added Returns:**	
None.			
Column Total	**$2,000.00**	**Column Total**	**$500.00**
Environmental Costs:		**Environmental Benefits:**	
1. Requires additional spreading on cropland at all times of year.		1. Increased average lagoon capacity makes spillage less likely.	
2. Solids have little fertilizer value.		2. Can be more flexible in timing lagoon clean-out.	
3. Requires more management and supervision to make system work.			

• Solids are too wet to be spread when first removed from the settling basin and must be air-dried further. A covered concrete pad that drains into the lagoon is needed.

• The slope of the settling basin floor is too steep for Mr. Hilley to easily operate a loader on it. A better method of removing solids from the basin is needed, or the floor needs to be flatter.

Mr. Hilley has also constructed a solid-set irrigation system to apply lagoon water on 70 acres of pasture. Nutrients from the lagoon water that might otherwise reach surface or groundwater are captured by the pasture, and, because application does not depend on weather, lagoon levels can be lowered when necessary, reducing the chance of lagoon overflow in periods of high rainfall. Mr. Hilley uses the system continuously, putting the increased forage production into both a stocker and a cow-calf enterprise.

David Johnson Farm

In another case, an environmental partial budget was used to evaluate whether a stocker enterprise should be added to an existing hog finishing enterprise. Stockers would graze pasture fertilized and irrigated by a solid-set irrigation system, using an existing lagoon as a water source.

Problem: Lagoon Capacity

David Johnson is an innovative farmer in Dekalb County, part of the Sand Mountain area of Alabama. He raises hogs in confinement near Rainsville. His modern hog facility is well constructed, clean, and up-to-date. He uses a flush water system to move manure into an adjacent lagoon. A large tank is slowly filled, and, when full, it is “tripped” to spill several hundred gallons of water into troughs that run under the slatted floors of the hog parlor. Manure is washed by this flood into the lagoon. The system works very well. The hog parlor is kept very clean and odors are reduced. The one drawback to this system is that several hundred gallons of water are added to the lagoon system daily. Because no overflow of any lagoon is ever allowable for environmental reasons, a way was needed to use this water. In summer, evaporation can handle the excess, but in winter or in rainy seasons, a way to remove the excess water without allowing it into creeks and streams was badly needed.

Solution

Mr. Johnson evaluated, with assistance from the Innovative Technology in Agriculture Project, a sprinkler irrigation system, using waste water from the hog lagoon, on about 15 acres of pasture. The pasture was established in endophyte-free fescue, and, because of the plant nutrients in the lagoon water, no other fertilizer was needed. Fescue was seen as a long-season grass that could effectively use nutrients in cool weather, when the need was greatest to reduce liquid level in the lagoon. Irrigation would be managed so that no runoff from the pasture occured. In this way, nutrients in the lagoon water would be “converted” into a valuable product—beef—and a potential problem—excess waste—would be transformed into a profitable enterprise. The EDB analysis of this change is shown in Table 4.

In this case, the economic net benefit was relatively small ($14,400 versus $14,575), but the environmental benefits weighed heavily in the decision.

A final example of using EPB to evaluate changes in a farming operation is illustrated by a farmer who considered adding a vegetable enterprise to use waste from a layer operation.

Table 4. Environmental Partial Budget For Costs And Returns For A Solid Set Irrigation System And Fescue-Based Stocker Enterprise.

Added Costs:		**Reduced Costs:**	
Equipment expenses	$ 1,400.00	Labor savings	$200.00
Stockers	12,000.00		
Pasture expenses	400.00		
Miscelaneous expenses	600.00		
Reduced Returns:		**Added Returns:**	
None		Feeder cattle	14,375.00
Column Total	**$14,000.00**	**Column Total**	**$14,575.00**
Environmental Costs: 1. Requires management of pasture to avoid over-applying nutrients that might leach to groundwater or run off into streams.		**Environmental Benefits:** 1. Increases average lagoon capacity, making overflow less likely. 2. More flexible in timing lagoon clean-out. 3. Lowers lagoon level in wet weather in emergency.	

George LaMunyon Farm

The George LaMunyon farm is located in west DeKalb County, Alabama, in the Sand Mountain area of the state. Mr. LaMunyon operates two caged-layer poultry houses, each with a capacity of approximately 30,000 birds. He also cultivates about 100 acres of cropland, planting corn and grain sorghum. Mr. LaMunyon has farmed since the early 1970s.

Problem: Wastewater Disposal

Over the years, Mr. LaMunyon has come to realize the importance of reducing pollution from his farm. He has had concerns about water quality downstream from the lagoon for his layer houses. He has also had concern about odor from land application of layer manure. Not only does Mr. LaMunyon recognize the importance of dealing with these potential problems, he also knows that the environmental impacts of his farming operation must be reduced. Although the farm has made important changes in waste handling systems, Mr. LaMunyon realizes that the waste management systems currently in place—and those planned for the future—will not completely solve his waste management problem. They will, however, provide options for handling waste at different times of the year and under different climatic conditions. Mr. LaMunyon is committed to further expanding his waste disposal options.

Solution

One of Mr. LaMunyon's options for disposal—using lagoon water to flood-irrigate vegetable production—was evaluated using EPB (Table 5).

Mr. LaMunyon received assistance from the Innovative Technology in Agriculture Project to install an irrigation system to flood-irrigate, from the second stage of the lagoon system, approximately 4 acres of cropland for vegetable production. Intensive vegetable production uses the plant nutrients in the waste before it can either run off into nearby streams or leach into groundwater. Spring plantings include tomatoes, sweet corn, snap beans, and cucumber. Harvest is timed to coincide with the decline of non-irrigated gardens.

Currently, the layer operation is the central enterprise on the farm, with row-crop and vegetable production ranking behind in importance, at least in financial terms. The existing two-stage lagoon system is operating at full capacity, especially during the wet season. Mineral (struvite) build-up in the system is increasing to problem levels.

To solve this problem, Mr. LaMunyon plans to lease some additional cropland adjoining his layer operation. He plans to establish this acreage in pasture and to install flood or sprinkler irrigation from the second-stage of the layer lagoon. He says that currently he lacks enough capability to reduce the liquid level in the lagoon system during the wet (winter-spring) months, and that the capability to spread lagoon waste-water on permanent vegetative cover will give him this added flexibility.

EPB Benefits

These farms in the TVA Innovative Technology in Agriculture Project illustrate how farmers may go about analyzing new technologies through Environmental Partial Budgeting to abate or prevent future environmental problems. Decisions are fairly easy when both the economic and envi-

Table 5. Environmental Partial Budget For Costs And Returns For Flood Irrigation Of Commercial Vegetable Production.

Added Costs:		**Reduced Costs:**	
Equipment expenses	$ 800.00	Labor savings from reduced lagoon management and liquid manure application.	$2,500.00
Machinery expenses	500.00		
Seed, plants	400.00		
Labor	3,000.00		
Miscelaneous expenses	600.00		
Reduced Returns:		**Added Returns:**	
None		Vegetable sales	2,500.00
Column Total	**$5,300.00**	**Column Total**	**$5,000.00**
Environmental Costs:		**Environmental Benefits:**	
1. Requires management of cropland to avoid over-applying nutrients that might leach to groundwater or run off into streams.		1. Increases average lagoon capacity, making overflow less likely.	
		2. More flexible in timing lagoon clean-out.	
		3. Lowers lagoon level in wet weather emergency.	

ronmental benefits outweigh the costs. The dilemma comes when costs (economic, environmental, or both) exceed the benefits:

• How can farmers be compensated for the benefits that accrue to the larger society?

• Should the farmer bear all the costs?

• If not, how does the public help bear the costs?

These are some of the questions that must be addressed.

In these specific farm examples, monetary assistance was provided, in most cases, through the Innovative Technology In Agriculture Project. Most of the technologies demonstrated positive economic returns as well as positive environmental benefits. These farms demonstrate methods whereby other farmers may adopt such practices to continue profitable as well as environmentally friendly farm operations in the future. EPB is a useful tool for analyzing both the economic and environmental trade-offs.

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