Appendix 5—Farmland Protection Programs in a Multi-Program Policy Environment

On an intuitive level, it should come as no surprise that farmland protection programs care most about protecting farmland. Yet, from the point of view of maximizing social well being, can we make better use of our rural land protection dollars? Does a predominant goal of "protecting agricultural viability" mean grand opportunities are being missed, that potentially valuable landscapes are being lost while a lesser amount of expensive farmland is protected?

When addressing this question, it is important to consider both the value of the various rural amenities, and the breadth of programs devoted to the protection of rural resources. Ultimately, what matters is the full set of rural amenities that are protected by this spectrum of programs, and not just those protected by any single program. From this viewpoint, the ultimate goal of the government as a whole (acting in the interests of the citizenry) is to maximize the net benefits (the benefits minus the costs) from protecting rural lands.

However, this level of integration is rarely found. Rather, the responsibility for rural land protection is often broken into several programs. For example, a State-run PDR program may coexist with State-run parkland expansion programs, wildlife habitat protection programs, county-level conservation lands, and Federal programs to protect riparian buffers. All of these provide rural amenities, and many of these may seek to protect identical parcels of land.

In this policy environment, efficient decision making requires some form of two-stage decision making. That is, to avoid wasteful replication of effort, there needs to be some way of directing the actions of separate programs. In this light, consider a stylized example that highlights the implications of inter-program coordination when structuring farmland preservation programs, an example that suggests reasons why the protection of farming may be a proper focus for farmland protection programs.

For simplicity's sake, assume there are two kinds of rural amenities. The first we call *viable ag*, the second we call *pastoral beauty*. The first is only provided by protection of active farmland,[1] while the second is provided by a variety of other rural lands, including farms. Given the wider array of lands that can provide *pastoral beauty*, we further assume that it is less expensive to protect a unit of pastoral beauty than it is to provide a unit of *viable ag*.[2]

Furthermore, suppose the existence of two independent programs whose mission is to protect rural landscapes:

1) An active farmland protection program (AFPP). The AFPP can protect either active farmland (providing *viable ag*), or other rural lands such as lightly used pastureland and woodlots (providing *pastoral beauty*)
2) A rural lands conservation program (RLCP). The RLCP can protect the same types of land as the AFPP.

Appendix figure 5.a depicts the information available to both program directors. Before the programs commence, both *viable ag* land and *pastoral beauty* are underprovided—the amenity value they provide is lower than the cost of provision.[3] Although the value of an additional unit of *viable ag* is higher than a unit of *pastoral beauty*, so is the price. Thus, as shown by the crosshatched rectangle, the net value of a dollar spent on *viable ag* will be less than a dollar spent on *pastoral beauty*.[4]

Ideally, land should be protected until Aopt units of *viable ag* and Bopt units of *pastoral beauty* are obtained. However, assuming both programs are operating with a limited budget, decisions must be made on how much of each amenity to protect.

[1] For this exercise, we abstract from the different kinds of farmland.

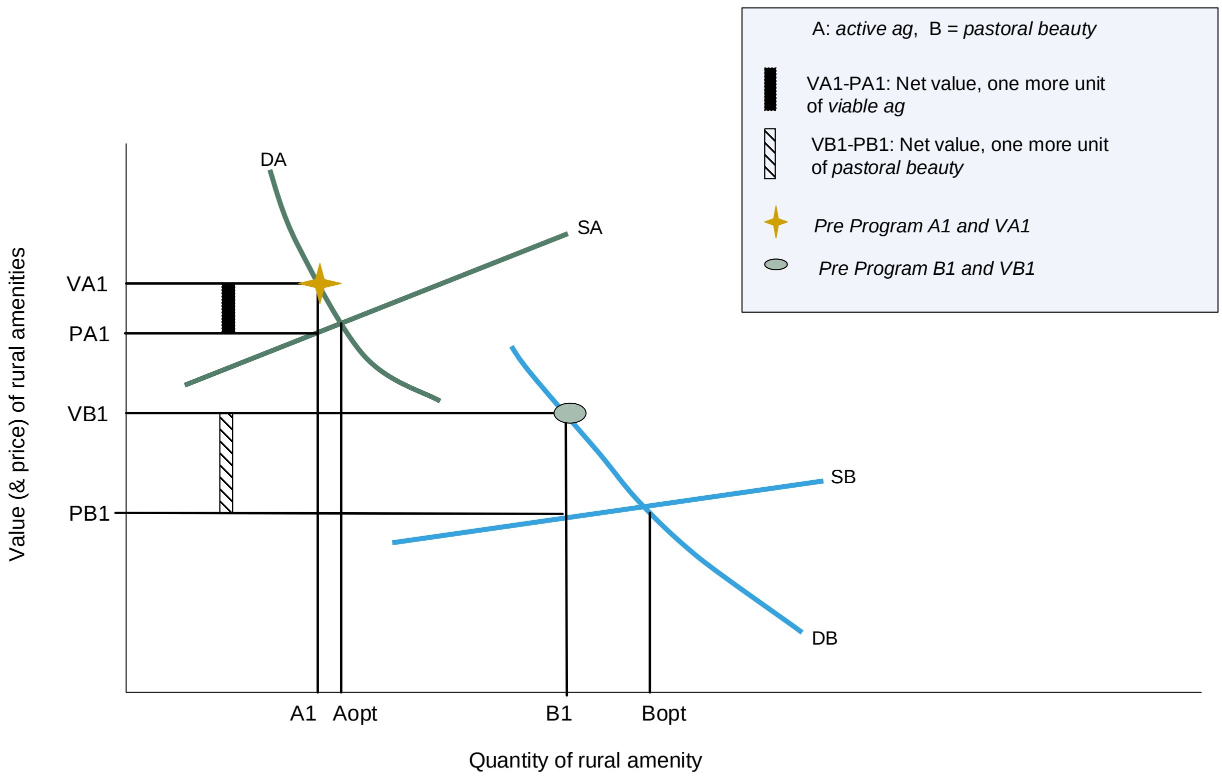
[2] As a simplification, assume that 1 acre of farmland provides one unit of the "active agriculture" amenity. Similarly, 1 acre of rural open space (whether it be farmland, pastureland, or woodlot) can provide one unit of "pastoral beauty."

[3] The amenity values are depicted in the demand curves (DA and DB). The cost of provision is depicted in the two supply curves (SA and SB). We assume that there is a one-to-one match between acres and units of the amenity provided by these acres.

[4] A fully specified comparison would require computation of the inframarginal value net of costs (taking into account the differences in quantities purchased with the same expenditure). However, in this example such a full computation will yield the same qualitative stories (a full story increases the differences between net values per dollar expenditure).

Appendix figure -5.a

Pre-Program: Supply and demand



The manager of the AFPP, acting independently and seeking to maximize social benefits, would use the information in appendix figure 5a to conclude that the AFPP's limited dollars should be spent on providing pastoral beauty. Similarly, the manager of the RLCP will conclude the same. The net result of these two "uncoordinated" decisions is depicted in appendix figure 5.b. No additional units of *viable ag* are protected, while *pastoral beauty* is almost at its optimum. Unfortunately, too much pastoral beauty was protected: the marginal net value of *pastoral beauty* is now smaller than the marginal net value of *viable ag*.

Now consider a two-stage process, wherein a first-stage decision-maker instructs each program manager to more heavily weigh a particular amenity (i.e., the AFPP gives more weight to *viable ag* when considering acres to protect). Then, the RLCP will not change (it will still *protect pastoral beauty*). However, the AFPP will eschew the seemingly more cost-effective acres providing *pastoral beauty* and purchase *viable ag* instead.

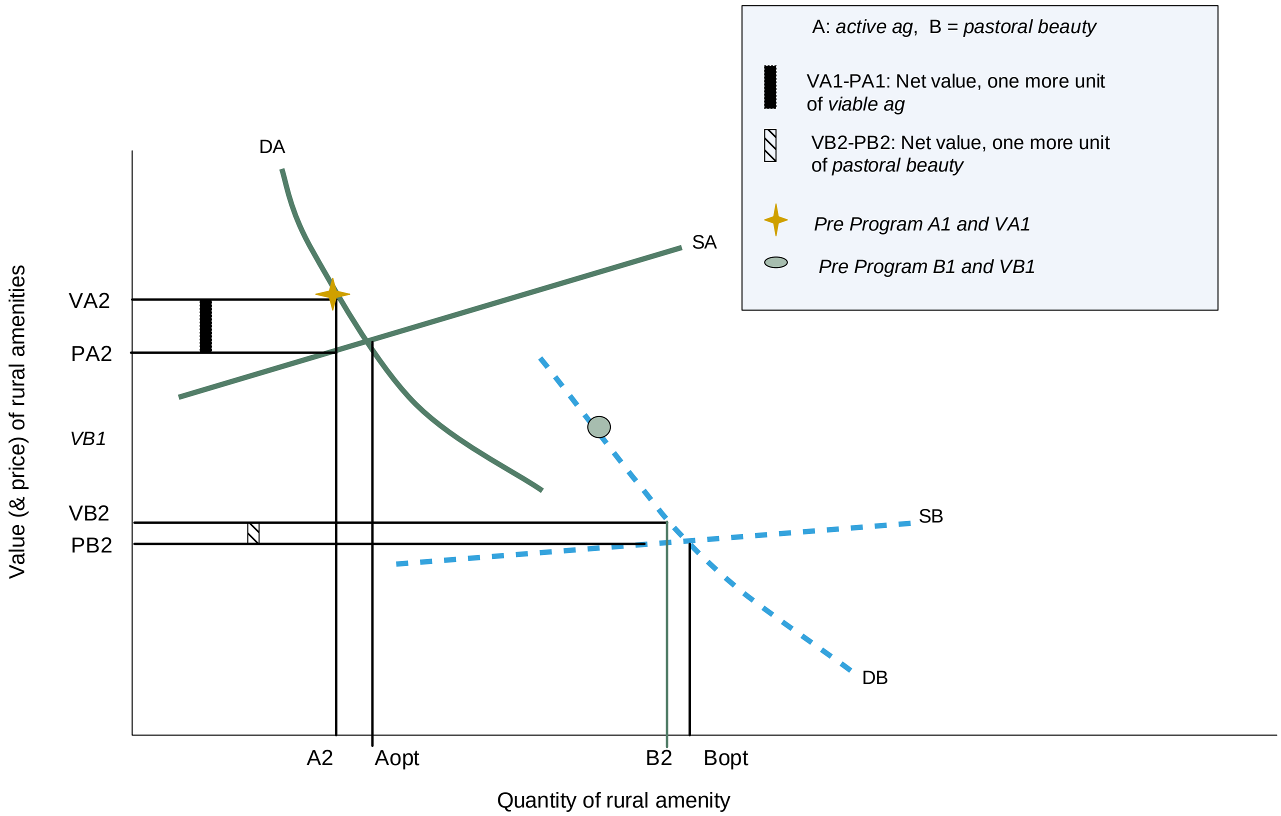
Appendix figure 5.c illustrates this scenario. The marginal values of *viable ag* and *pastoral beauty* are equivalent, hence there would be no net gain from moving funds between programs.

Thus, by using different weightings (on what amenities are most important) in each of the two programs, a more efficient outcome is obtained. Of course, this fortuitous outcome depends crucially on a set of first-stage decisions regarding the level of funding of each program, and the set of weights adopted by each program manager. In other words, in a policy environment where different programs have overlapping but essentially independent missions, determining the right mix of funding and decision rules requires that the first-stage decision maker (the highest levels of government) consider the second-stage responses of all the program managers.

For example, appendix figure 5.d illustrates how a first-level decision rule could be derived. Here, information from appendix figure 5.a is used to determine **net value** functions for an additional unit of each amenity, computed as the difference between the demand and supply curves. This **net value** (the Y axis) is plotted against the price (the X axis). Basically, as the quantity of an amenity increases, the **net value** of an additional unit decreases—since both the marginal cost for an additional unit goes up, and the marginal value of this additional unit goes down. At the price where demand equals supply, the **net value** becomes 0.

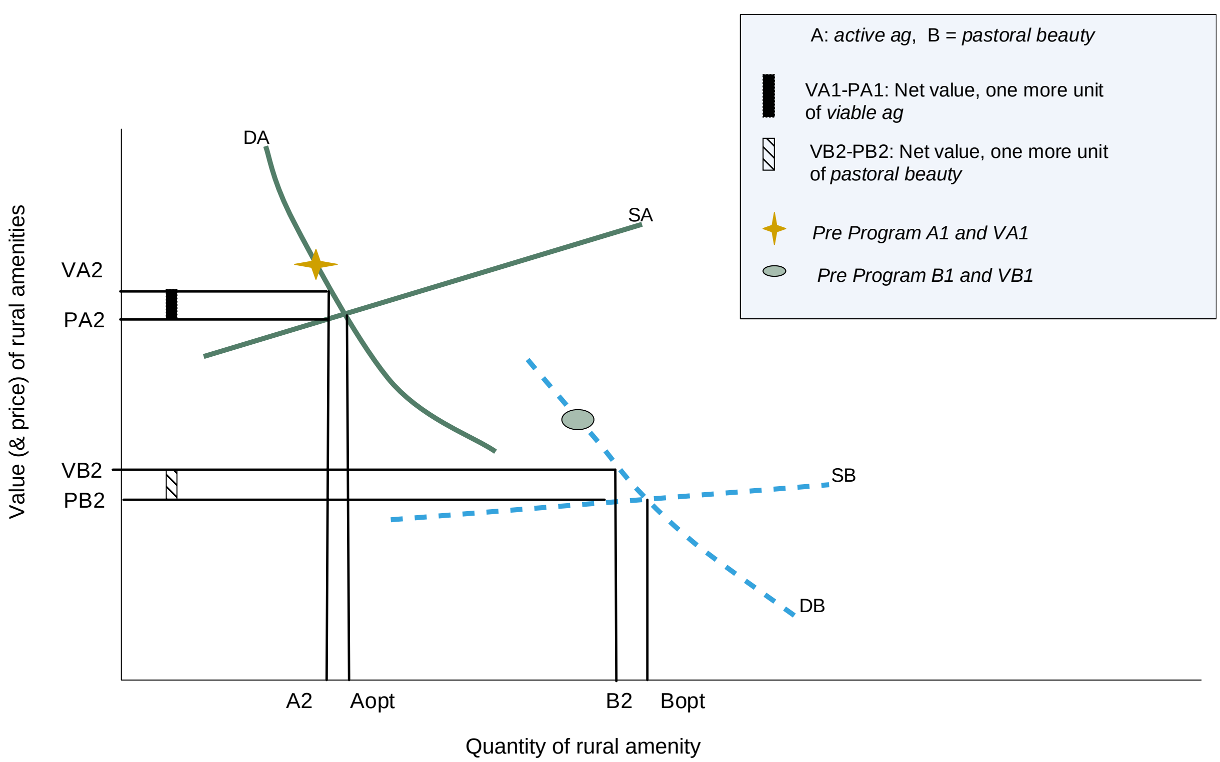
Appendix figure 5.b

Post-Program: Uncoordinated actions



Appendix figure 5.c

Post-Program: Budget constrained (coordinated) optimum



With adequate budgets, expenditures on *active ag* and *pastoral beauty* should continue until the **net value** of an additional unit is zero; which occurs at PA* and PB* respectively. However, when budgets are limited, social welfare is maximized when purchases of each amenity equate the **net value** per extra dollar of expenditure. This is achieved along *expenditure-rays*[5] starting from the origin, where an intersection of a *expenditure-ray* with a **net-value** line indicates the *maximum price that should be paid for this amenity* (at this budget). Higher budgets are associated with flatter *expenditure-rays*, since flatter rays imply a willingness to pay a higher price per amenity.

The example in figure 5.d highlights that at sufficiently low budgets, it is not worthwhile to spend anything on *active ag*—the net value (per dollar of cost) for an additional unit of *active ag* is always less then the net value (per dollar of cost) for an additional unit of *pastoral beauty*. As budgets increase, the price that the government is willing to pay for *pastoral beauty*, and for active ag increase, and eventually purchases of *active ag* occur.

This suggests how a first-stage planner could allocate funding and set rules. For example, the different programs could be instructed to focus on one type of land only. Then, the *maximum prices* are determined by reading where a candidate *expenditure-ray*, intersects the **net-value** curves. The quantities associated with these *maximum prices* are then read from the demand curves of appendix figure 5.a. With these current and desired quantities (and the current prices and the *maximum prices*), a budget could then be allocated to each agency. Assuming one's demand and supply curves are accurate, the narrowly focused agencies will purchase the appropriate quantities of rural amenities, a quantity that maximizes net social welfare as summed across all agencies.[6]

[5] Along an expenditure-ray, the ratio of the "net value of an amenity" and the "price for additional unit of an amenity" is constant. Thus, at the points where an expenditure-ray hits two net-value curves, the net-value for an additional dollar of expenditure is equated.

[6] After obtaining these quantities and prices, the total dollar outlay associated with a candidate expenditure-ray can be determined. Hence, in practice the first-stage planner could iteratively examine different expenditure-rays, and then choose the one that yields a dollar outlay equal to the first-stage planner's budget. Of course, this assumes that the first-stage and second-stage planner both have the same, accurate demand and supply curves.

Appendix figure 5.d
Determining optimal allocation of funding between different rural amenities