ACCOUNTING FOR THE SOCIAL BENEFITS AND COSTS OF DEVELOPMENT RIGHTS PURCHASE PROGRAMS*

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Public programs of agricultural preservation continue to be of interest in many states of the urbanized Northeast. Farmers themselves, of course, have always been concerned with this issue, and in recent years they have found effective allies among public planners, for whom the agricultural sector has become a chief source of scenic and cultural amenities as well as insurance against unforeseen disruptions in future supplies of food and fiber. Programs of use-value assessment have been enacted by almost all of the northeastern states, as well as by those in many other parts of the country. Partly as a result of the fact that the effectiveness of this approach has been in doubt, attention in some states is turning to programs in which the development rights are purchased from agricultural land in order to alleviate development pressure on these areas. New Jersey has recently undertaken a program of development rights purchase, Massachusetts is currently shaping legislation for such a program, and many other states have shown interest.

To the staunch political advocates of this technique the question of its social desirability is not in doubt; their implicit benefit-cost computations come out clearly with positive net benefits. Yet the approach apparently has never been subjected to a straightforward social benefit-cost analysis using the tools that give economists the putative advantage over other public policy disciplines. Considering the relatively large sums of public monies that are contemplated for these programs, this analytical gap may have serious implications given the inefficiencies and inequities that could creep into such plans.

We have not attempted in this paper to construct a highly sophisticated benefit-cost analysis of development rights purchase programs. Rather, we attempt to construct some very basic expressions through which

*Paper No. 2122 Massachusetts Agricultural Experiment Station, University of Massachusetts at Amherst. This research supported (in part) from Experiment Station Project No. 395.

we may account for the primary social benefits and costs of development rights purchase programs. We attempt to use these expressions to derive criteria useful to public agencies whose responsibility it is to conduct these programs. Lastly we illustrate, using realistic data, how the criteria might be applied in practice and some of the implications of their application.

Analysis of Benefits and Costs

Let us assume that a state agency is charged with purchasing the development rights from agricultural land within the state, and that the monies to affect these purchases are appropriated from some wide social group within the state; perhaps the general taxpayer, the general food buyer, the general real estate purchaser, or some other group. To make the analysis simpler we will assume further that the agricultural land in question is threatened by housing development. Although in reality we know that industrial and commercial development may also cause agricultural displacement, these developments may be analyzed in ways strictly analogous to the treatment that follows. We assume that, if development is precluded on the agricultural land in question it will be deflected to "alternative" land, which might be woodland, upland, or even other agricultural land. Further assumptions will be made in the process of introducing the main list of variables. These are:

V_o: the marginal private agricultural value of the land which is a candidate for a development rights purchase.

V_s: the marginal social value of agricultural land, exclusive of private use value. This includes such items as amenity value, ecological value, and the like. For simplicity we assume that these values accrue entirely to the general (state) society.

P_f: selling price of the housing built on agricultural land should development proceed.

W_f: public costs associated with housing on agricultural land (e.g., roads, sewers).

C_f: private costs of constructing housing on agricultural land.

P_a: selling price of the housing on the alternative land to which development is deflected if development of the agricultural land does not proceed.

W_a: public costs of constructing housing on the alternative land.

C_a: private costs of constructing housing on the alternative sites.

V_r: the marginal private value of land in the alternative site area.

V_a : the non-private environmental value of land in the alternative area.

P : the probability that, if no development right purchase program were undertaken, the agricultural land in question would be developed.

D : the payment made by the public agency to farmers in return for the development right to the agricultural land.1/

It should be clear from the variables as defined that given competitive conditions and the marginal cost pricing of public utilities, $P_f = V_o + C_f + W_f$, and $P_a = V_r + C_a + W_a$. That is, the selling prices for houses include the value of the land, construction costs and public utilities for the agricultural and alternative areas respectively. Similarly the selling price of undeveloped land in the two areas would be, $P_f - C_f - W_f = V_o$ and $P_a - C_a - W_a = V_r$ respectively.

It is clear that we have simplified the analysis to a considerable extent. We have adopted only two variables, V_s and V_a, to capture the environmental impacts of land use; these impacts are actually likely to be multifaceted. We have not explicitly introduced a variable to capture the risk aversion effect, that is, the desire to avoid an irreversible reduction in an important agricultural input in case expanded local food production is called for at some time in the future. This is a complex question and it is not clear how it should be entered into the analysis;2/ we will assume simply that the variables V_o and V_s subsume this effect. We have assumed away any interaction effects between the purchase of development rights from some agricultural land and the private and public values of remaining agricultural land; it would lend a touch of realism to include this effect but the added complexity would obscure the basic message.

It is assumed that new housing will be built either on the agricultural land or in the alternative area.3/ Since the demand for new housing is created chiefly by growing population, we have a problem that ordinary welfare analysis is ill-equiped to handle. That is, ordinary welfare principles apply to fixed populations, while here we have a larger population after development. Thus it must be assumed that new houses are occupied by new residents, either from immigration into the state or by newly formed households within the state. The total change in welfare must be equal to the welfare change of existing residents plus

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1/All of the variables are per-acre values.

2/Some of these complexities are explored in [1].

3/We repeat, the analytical approach would work equally well for commercial or industrial types of development.

the welfare change of new residents. Therefore a means of measuring the latter must be determined. Ideally we should find this by comparing the welfare of these new residents before and after entering the region. Unfortunately this approach is impractical. Instead we have adopted an ad hoc means of addressing this problem. If we assume that the new residents will be inelastically "supplied" to the region, and that houses are of the same quality wherever they are built, then we would be justified in concluding that the welfare of immigrants would be unaffected by the development rights program as long as $P_a = P_f$, that is, as long as the selling price of new houses was unaffected by the program. Under the assumption of constant quality, then, we may use the quantity $P_a - P_f$ as an index of the welfare effects on new residents. It is to be noted that this effect is pertinent only if development proceeds on the alternative land rather than the agricultural land.

We may now proceed to find an expression reflecting the net social benefits of development rights purchase. If development proceeds on the agricultural land net social benefits will be:

$$(P_f - C_f) - V_o - V_s - W_f, \tag{1}$$

that is, benefits will go up by the selling price of the housing minus the cost of producing it, which includes construction costs, lost agricultural production, amenity values of the agricultural land, and costs of public utilities. If development takes place on the alternative land, the expression for net benefits is:

$$(P_a - C_a) - V_a + (P_f - P_a) - V_r - W_a. \tag{2}$$

Expression (2) is analogous to (1) except that it contains the term $(P_f - P_a)$ which is the index of impact on new residents.

Since development on the agricultural land proceeds with probability P and on the alternative land with probability 1-P, the expression for expected net benefits <u>when there is no development rights program</u> is:

$$P[(P_f - C_f) - V_o - V_s - W_f] + (1-P)[(P_a - C_a) - V_a + (P_f - P_a) - V_r - W_a]. \tag{3}$$

If a development rights program is instituted, the implication is that housing development will in fact occur on the alternative land rather than the agricultural land. Expected net benefits in this case are therefore given by:

$$[(P_a - C_a) - V_a + (P_f - P_a) - V_r - W_a], \tag{4}$$

which is exactly the same as expression (2). To find the net gains from a preservation program we subtract (3) from (4) giving

$$P[(P_a - C_a) - (P_f - C_f) + V_o + V_s + W_f + (P_f - P_a) - V_a - V_r - W_a]. \tag{5}$$

It is obvious that the net benefits of a preservation program are zero if there is a zero probability that the land will be developed. Positive net benefits imply that

$$V_o + V_s > (P_f - C_f - W_f) - (P_a - C_a - W_a) + (V_a + V_r) + (P_a - P_f). \qquad (6)$$

Condition (6) says that positive net benefits require that the sum of use value and environmental value of the agricultural land exceed the sum of: (a) the discrepancy in market price of land between the two areas, (b) the sum of existing use value and environmental value of land in the alternative area, and (c) the discrepancy in house prices between the two areas. The presence of the last term is again to be noted. This is the measure of the impact on new residents, implying that everything prior to this term measures the impact on existing residents.4/

We will use expression (6) to consider development rights purchase programs in selected real-world communities. In order to highlight the more important implications, consider for a moment the consequences of letting $P_a = P_f$ and $W_a = W_f$; that is, letting the selling price of housing and the public utilities cost of housing be the same. Thus the program would have no impact on new residents, any differences in construction costs being absorbed by landowners. While these assumptions are not necessarily realistic it may nevertheless help to inspect the condition for positive net benefits when they are involved. Incorporating these two assumptions, expression (6) becomes:

$$V_o + V_s > (C_a - C_f) + V_a + V_r \qquad (7)$$

implying that in order for the development rights program to have positive net benefits it is necessary that the sum of agricultural and environmental values of agricultural land exceed the sum of: (a) the amount by which house construction costs increase with the program, and (b) the sum of existing use value and environmental value of land in the alternative area.

Distributional Effects

In the analysis above there are basically five groups involved: farmers, landowners in the alternative area, home buyers, local taxpayers and the rest of society. Table 1 summarizes the net gains for each group.

4/ The presence of the last expression may also convey the impression that the quantity $P_f - P_a$ is being double counted. In effect it is, but the second counting (as $P_a - P_f$) refers to a different group of people (immigrants). It needs to be repeated that this is the ad hoc way chosen to treat the question of changes in net benefits when the population of the area changes, a problem that standard welfare analysis does not treat.

Table 1: Net Gains of Sub-groups from a Program of Development Rights Purchase

	Net Gains
Farmers	$D - P[(P_f - C_f) - V_o]$
Landowners in alternative area	$P[(P_a - C_a) - V_r]$
Home buyers	$P(P_f - P_a)$
Local taxpayers	$P[W_f - W_a]$
Rest of society	$P(V_s) - D - P(V_a)$

Note that in none of the expressions so far has D appeared. D is the payment made to farmers for the development rights, and affects how the net benefits of the program might be distributed. Consider, for example, a situation where D is equal to zero since development on agricultural land has been foreclosed by fiat. In such a case, the total net benefits of the program to society would remain the same, with farmers bearing most of the cost. When D is some positive value the cost to farmers will decrease. Provided that $D = P[P_f - C_f) - V_o]$, i.e., the amount received for the development rights is equal to the actual value of the development rights, then farmers will be left in a neutral position; the rest of society will gain, however, as long as $P(V_s) > D+P(V_a)$, i.e., as long as the amenity values of farmland exceed the payment made by society for the development rights plus the amenity values lost when development is diverted to the alternative area. Landowners in the alternative area are benefited as long as the probability of agricultural development is non-zero. If it is zero, it implies that development is going to settle on the alternative anyway, and nothing is to be gained by them from a program of agricultural development rights purchase. Home buyers are unaffected as long as the development rights program does not affect the price of housing, and local taxpayers as long as public service costs are the same in each area.

It is to be noted that the distribution of net gains between landowners and the rest of society can be easily affected by taxes of various types. A capital gains tax, for example, could be used by society to recapture a portion of any gain made by farmers or other landowners. These taxes are purely transfer payments; it is strictly illusory to treat them as real benefits and costs.

Applications

The approach which we have outlined permits us to evaluate in a straightforward manner the net social gains produced by any specific purchase of development rights. Obviously the accurate measuring of environmental values is a problem not easily circumvented. In fact, it was in order to clarify this issue that many of the unrealistic, but peripheral, assumptions were made. The point of this analysis is to demonstrate that by using the values for variables that are readily available, such as for P_f, V_o, and the like, and by manipulation of the expressions presented, it can be shown what the unobtainable values, V_s for example, must be in order for the net benefits of a development rights purchase to be positive. Note that this method does not produce an empirical value for the variables such as V_s. Rather, it is often the case that we have a preconceived ordinal notion for environmental and amenity values. The knowledge of critical values which must be exceeded in order to maintain positive net benefits for a development rights purchase can be used to gauge the magnitude of these "notions."

We have obtained data from several Massachusetts communities to illustrate the approach. These data are shown in Table 2. They were obtained by informal means, and we cannot be sure that they are absolutely typical of the communities. Yet they can provide suggestive conclusions regarding development right values. Using these data in expression (6) we find that net benefits of agricultural land preservation in the communities will be positive as long as the following conditions hold:

Community A[5/]

(1): $V_s > \$2850 + V_a$

(2): $V_s > \$2250 + V_a$

(3): $V_s > -\$950 + V_a$

Community B

(1): $V_s > \$1100 + V_a$

(2): $V_s > \$900 + V_a$

Community C

(1): $V_s > \$2600 + V_a$

Community D

(1): $V_s > +\$50 + V_a$

(2): $V_s > \$450 + V_a$

We note that there is a wide range of environmental values produced by specific agricultural lands that will justify preservation. In fact, on agricultural use (3) for community A preservation is justified even in the absence of environmental values, owing to the high agricultural use

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5/Number in parentheses under each community refer to agricultural use values shown in Table 2.

Table 2: Land Price and Construction Cost Data from Selected Massachusetts Communities

Item	Community A	B	C	D
	$	$	$	$
Market prices of housing				
Agricultural land (P_f)	22,500	25,000	22,000	19,000
Alternative land (P_a)	22,000	24,000	25,800	18,800
Construction costs				
Agricultural land (C_f)	17,500	17,000	20,000	18,200
Alternative land (C_a)	20,000	18,000	24,000	18,700
Public utility costs				
Agricultural land (W_f)	1,000	1,000	1,000	800
Alternative land (W_a)	1,500	1,000	2,000	800
Agricultural use value* (V_o)				
(1)	200	400	2,500	500
(2)	800	600		100
(3)	4,000			
Use value of alternative land (V_r)	50	500	100	50

*Agricultural use value will clearly vary of agricultural fertility and crops grown. Those shown are values pertinent to different types of agricultural enterprises in each town.

values. In community C, where only one type of agricultural enterprise exists, a relatively high use value is offset to some extent by large differences in construction costs, so that the environmental value of farmland there must be high to justify preservation. On agricultural use (1) of community D it will be noticed that the effects of the different factors is nearly self cancelling, implying that agricultural preservation is socially desirable as long as the environmental values produced by the farmland exceed those lost when land in the alternative area is developed.

Value of Development Rights

This approach may also be used to calculate values of development rights. Suppose we make the assumption that we wish to value development rights so that the welfare of farmers is left unchanged by the program. In order to make accurate estimates of these values it is necessary to estimate the probabilities that land will be developed if no program were developed. These probabilities can then be used directly in the expressions of Table 1, showing the net gains to different groups. Assuming, by way of example, that the probability of a developer knocking on the door of a farmer of type (1) in Community A is P = .6, the value of the development right to this farmer, that is, the value that will leave his net benefit position unchanged, is (.6) ($5000-$200) = $2,880. To find out the value of that development to society at large, of course, it would be necessary to have measures of V_s and V_a.

Summary

We have tried to develop a simple means of accounting for the benefits and costs of agricultural preservation in communities of the Northeast. The basic variables entering into this accounting are not only agricultural use values and environmental values, but private and public cost differences stemming from the fact that development is deflected away from the preserved agricultural land into alternative areas. The approach lends itself easily to constructing rules of thumb by which public agencies charged with purchasing development rights could determine whether any particular purchase would lead to an increase or a decrease in net benefits accruing to society.

References

1. Field, Barry C. and P. Geoffrey Allen. "Subsidization of Agriculture in Urbanizing Regions." mimeo, Department of Food and Resource Economics, University of Massachusetts, 1976, 12 pp.