

ECONOMIC EVALUATION OF A REBATE PROGRAM FOR SAVING WATER: THE CASE OF MESA

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ABSTRACT

In July of 1984, the City of Mesa, Arizona, implemented a voluntary water development fee rebate program to encourage new home builders and owners to adopt water saving desert landscaping. It is concluded on the basis of benefit cost analysis that the program was successful for single-family residences. It was also found that the program financially favors multifamily development over single-family residential housing. Finally, it is concluded that the program may not be sufficiently publicized and may not appeal to high income home buyers.

In 1980, the Arizona legislature passed the Groundwater Management Act [1]. This act established the Phoenix Active Management Area (AMA) and set management goals for each of five management periods to achieve a goal of safe-yield, a long-term balance of withdrawals and recharge, by the year 2025. Mesa is a rapidly growing city, both in population and water use, in the Phoenix AMA. It satisfies about 60 percent of its water demand by pumping groundwater. Under the Groundwater Act, Mesa is required to reduce its per capita water consumption by 6 percent before January, 1987.

Given the rapid population growth's pressure on water supply, in 1981 the City of Mesa adopted an increased water development fee to be imposed on new housing units and provided for the future implementation of a program to offer

rebates to new construction choosing desert landscaping [2]. The fee is paid at the time the building permit is issued and the funds received can only be used for capital outlay or debt service associated with the water system. Since sprinkling demand of lawns greatly contributes to peak water demand, Mesa hopes to partially meet the required 6 percent reduction through a partial rebate of the water development fee to be paid to owners or developers of new homes for installing desert landscaping from an approved list of more than 300 plants, trees, and shrubs [3]. Mesa's Water Connection Fee Refund Program (WCFRP) implemented in July of 1984, is a voluntary incentive program that pays a refund of \$147.00 for a typical single-family home, and up to several thousands of dollars for a large multi-unit housing complex. The program simply requires the developer or homeowner to file an application for a refund and allow for inspection when the landscaping is completed. This program is applicable to new developments and avoids the political problems of older residential areas perceiving themselves as subsidizing new developments. This article is devoted to evaluating the economics of the Mesa WCFRP program.

ECONOMIC EVALUATION

The City of Mesa program is an economic measure designed to control residential water demand. Its intention is to offer an economic incentive, the refund of the water development fee, to install desert vegetation in new housing. The typical fee reduction of \$147.00 per residential unit is small compared to the price of a new residence. However, this saving is in addition to substantial savings in water bills, maintenance costs, and installation costs associated with selecting desert landscaping in preference to more water-using landscaping choices. At the margin, it is likely that some consumers will be influenced by the rebate to adopt desert landscaping. Since multiple housing units, notably apartments and condominiums, receive refunds on their water development fees based on the number of housing units multiplied by the per unit rebate, it is obvious that these units will typically receive much greater refunds per square foot of land developed. Thus, for the marginal consumption decision, the program favors adoption of desert vegetation by developers of multiple housing units rather than single-family home builders or owners. If Mesa expects a higher ratio of multiple dwelling units to single units, the program could prove to be very effective in saving water. In general, the greater the price elasticity of demand for housing and the more indifferent the buyers are to vegetation type, the more likely the program will succeed in meeting its objective. This is true for both single-family residences and multifamily residences.

A potential economic problem with the program is that high income consumers with a strong preference, low price elasticity and high income elasticity of demand for water-using vegetation, may not be affected by the relatively small change in comparative landscaping option costs offered by the

program. A recent study has shown these consumers to utilize considerably greater than average quantities of water in Tucson, Arizona [4]. Thus, if a mix of housing develops in Mesa that contains an increasing proportion of high income households with a strong preference for water-using vegetation, the refund program may not be successful. A program to influence attitudes may be more cost effective [5].

A second potential economic problem can be seen in the rebate itself. If there is a general increasing trend to install desert landscaping, then a number of rebate takers may represent residence owners and developers who intended to install desert landscaping in any event, because of the other types of savings mentioned above. In these cases not easily identified, the city treasury is spending \$147.00 per residence with no actual gain in water saving other than the possibility that the official plant list provides water savings above that of the desert landscaping usually installed.

THE CASE STUDY—THE SURVEY

This investigation of the Mesa rebate program was conducted in the Spring of 1986. At that time, holders of about 3 percent of the total building permits issued since the refund program was initiated became participants. No cases of the refund group were found in a 5 percent random sampling of the 3,224 new residential units in 1985. However, approximately 36 percent of the 1985 sample already committed to landscaping had desert landscaping when visited by the researcher. The remainder had either full lawns or half desert/half lawn landscaping. In addition, 51 percent of the total 1985 sample households were not yet committed to a landscaping type. A chi-square test comparing the selection of landscaping type from a 5 percent sample of pre-rebate homes built in 1983 with the sample of those committed to landscaping in the 1985 sample showed a significant difference in the mix of landscaping. The selection of desert landscaping in the 1985 sample was 36 percent compared to 17 percent in the 1983 sample. This lends support to a recently observed desert landscaping trend [5]. A second finding is that the percent of new homes with full lawns only changed from 58 percent to 55 percent in the two-year period of 1983-1985. Thus, the majority of the new desert landscapers appear to come from persons who in the past had a preference for half desert/half lawn landscaping. This would make sense as these persons would have a lower opportunity cost for giving up full lawns and would, therefore, be closer to the economic margin for adopting desert landscaping.

METHODOLOGY: BENEFIT-COST ANALYSIS

To ascertain the economic success of the WCFRP in benefit-cost terms, the value of the water saved was estimated on the basis of the assumption of a ten-year life of the landscaping and ownership. Unfortunately, only single-family

residences could be used to study the benefit-cost ratio of the program because water metering records for centrally metered multifamily units were not readily decipherable. Since the city cost per building is higher and the square foot of landscaping per residential unit is usually lower for multifamily units, the estimated benefit-cost ratio to the city per single-family residential unit is likely to exceed that of multifamily units taken alone or of the community wide average. Since 85 percent of the new 1985 housing units, down only 3 percent from the 1983 sample, were single-family residential units, it is likely that the calculated benefit-cost ratio is a reasonable representation of the situation in Mesa.

Since 1985 water use for homes outside the rebate group was unavailable in Mesa, it was necessary to utilize the 1983 water use [3] of the sample of 1983 homes with water-using landscaping in estimating the water savings of the rebate program. The amount of the water saved was estimated by subtracting the average 1985 water use of the rebate homes from the average 1983 water use of the 1983 homes with water-using landscaping, on a monthly basis, for the typical May to October Arizona sprinkling demand period [5]. *T*-tests of monthly rainfall revealed that only two months differed in the May to October period between 1983 and 1985. In addition, these differences were largely offsetting and are assumed to be so in this article. *T*-tests of the average desert landscaping monthly water-use patterns for May to October showed no difference between the rebate group and the 1983 samples in the desert landscaping group. This is further evidence that the water-use statistics for 1983 and 1985 were similar.

The average annual value of the water saved was obtained by multiplying the price in Price Zone 1 [3], where all the rebate homes are located, times the average annual estimated amount of water saved by a single-family residence. The typical single-family residential connection of 3/4" pipe was assumed for billing purposes. This billing option stipulates that 3,000 gallons are included in the connection fee, a price of 60 cents per 1,000 gallons is charged for the next 9,000 gallons, and 80 cents per 1,000 gallons after 12,000 gallons. Since the typical desert water-users exceeded 6,000 gallons in the sprinkling demand months, only the 60 cents and 80 cents marginal water rates were utilized in calculation of the average annual value of the water saved.

It was assumed that the average homeowner would have a ten-year time horizon and that the annual rate of the water saved would remain constant in 1985 dollars. Thus, a discount factor for an annuity could be applied to ascertain the present value of the water saved. The discount factor selected for the City of Mesa was 8 percent, its cost of capital for water development bonds. The present value of water saved per single-family residence was calculated by the formula:

$$P = (a) (s) (d)$$

where:

- P = the present value of water saved
 a = the appropriate discount rate for an annuity of ten years
 s = the price schedule (relevant portion for change in water use)
 d = the differences in water use between the rebate group and the 1983 water-using landscaping samples

The annual value of the water saved to the city was \$69.62 and its present value was found to be \$467.15. The benefit-cost ratio for the refund program was calculated by dividing present value of the saved water per household by the cost of \$147.00. The inspection costs were assumed to be 0 in this case. The result was a benefit-cost ratio of 3.2. Using the above figures, net present value of water saved per rebate was \$320.15 for the City of Mesa.

POLICY RECOMMENDATIONS AND CONCLUSIONS

The large number of 1985 owners with desert landscaping not participating in the WCFRP shows either the indifference of housing consumers to saving \$150.00, or lack of publicity concerning the refund program. It may be that single family residences, owners and builders, value the rebate less than the time spent filling out forms, complying with the regulations, or waiting for inspectors. On the other hand, Mesa did not publicize the program by including a notice of it with building permit application forms. Finally, many homes in the 1985 sample that had postponed landscaping may still take advantage of the rebate.

On the basis of benefit-cost analysis, the rebate program appears successful at this stage. However, the rebate may be too low to influence high income homeowners who might strongly prefer lawns. Additionally, it may take a sliding scale forcing single-family residences to place the compliance rate of these residences on par with multifamily units who normally achieve greater economies of scale landscaping. In fact, the benefit to cost ratio for multiple unit housing may not be favorable for the city, as the rebate paid per square foot of landscaping is essentially much larger for the multiple units. Finally, the small number of participants suggest that greater publicity to the target market, new housing units, is needed. Including a notice of the program in the forms for building permit applications or in the recording process of deeds when developers first sell unlandscaped homes to their first owners would be an obvious solution to this marketing problem.

REFERENCES

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