7-25-2007

Cost Benefit Analysis of Wastewater Reuse in Israel

Doron Lavee
Tel-Hai College, Israel

Nir Becker
Tel-Hai College, Israel

Abstracts of the presentations given on Wednesday, 25 July 2007, in Session 11 of the UCOWR Conference.

<u>Cost Benefit Analysis of Wastewater Reuse in Israel</u>

Doron Lavee
And
Nir Becker

Department of Economics and Management
Tel-Hai College
Upper Galilee
12210, Israel
doron@pareto.co.il

<u>Extended Abstract</u>

<u>Introduction:</u>

The state of Israel has semi arid climate conditions. In order to operate a desirable and productive agricultural sector, demand and supply of water need to be carefully and thoughtfully managed. This paper deals with one method of supply management, namely wastewater reuse for agricultural purposes.

Wastewater reuse has promising characteristics from a number of perspectives:

1. Wastewater is an environmental nuisance which requires some form of a removal solution. Wastewater reuse for agricultural purposes solves the removal problem.
2. The cost of providing water suitable for agricultural purposes through wastewater reuse is lower than the cost of alternative sources intended to increase water supply (e.g., desalination).
3. Wastewater sources are a reliable and relatively constant source of water supply. Hence they play a role in reducing uncertainty.
4. The source of wastewater supply is within the domestic sector. This is the same sector that consumes the agricultural products. Hence, there is a strong correlation between agricultural product demand and the supply of treated wastewater.

In recent years there has been a gradual increase in the use of treated wastewater for agricultural purposes: in the year of 2003 more than 60% of wastewater in Israel was reused in agriculture. The plan is to reach a 100% reuse target by the year of 2017.

However, using treated wastewater for agricultural purposes also carries risks and could potentially cause damage. Two major types of problems are identified: a negative effect of the use of treated wastewater on the productivity of certain crops and potential damage to groundwater aquifers.

The purpose of this paper is to conduct a Cost Benefit Analysis (CBA) for different options of reuse. The paper deals with the entire country as one unit; in a following paper we intend to look at different regions separately. It should be emphasized that the purpose of this paper is not to compare wastewater reuse to other options for dealing with wastewater and/or supplying water for agricultural purposes (such as direct removal of wastewater and the use of fresh water from other sources instead). Rather, this paper evaluates the costs and benefits of setting different wastewater standards. Hence, transport costs of treated wastewater to the fields and the current basic water quality level were NOT subjected to a CBA, as for the purpose of this paper these variables are fixed. Only the incremental costs and benefits associated with setting higher treated wastewater standards were subjected to the CBA.

The different alternatives:

In order to determine the best alternative from a cost benefit perspective, there were two main water quality parameters which were grouped together: the **sanitary** group and the **salinity** group. The reason for this is simply because an entire group like that can be treated with one common technology.

The different treatment options are specified below:

The sanitary group:

- Basic existing treatment level
- Intermediate treatment level
- High treatment level

The difference between the intermediate and high treatment levels lies only in the removal of nutrients, which is required in the high level of treatment while not required in the intermediate one.

The salinity group:

- Basic treatment level, requiring no change in the desalination level.
- Intermediate treatment level, requiring a first degree desalination level of sea and brackish water.
- High treatment level, requiring a second degree desalination level of sea and brackish water.

The entire set of alternatives consists of all combination pairs of the above possibilities. That is, there are 3^2 (=9) alternatives.

<u>Cost Benefit Methodology:</u>

The CBA methodology deals with the costs and the benefits separately. For both the costs and the benefits we analyzed the incremental change associated with moving from one standard level to a stricter one. The preferred alternative is the alternative that has the highest net benefit of the 9 alternatives.

Cost Analysis:

At the first stage, all available technologies to meet a given standard were identified. In the next stage we chose the most cost effective technology. We then identified the critical parameter in each group. This was done by gradually lowering the costs associated with the use of the treatment technology until the standard for any of the parameters was violated (the first parameter for which the standard was violated being the critical parameter).

Benefit Analysis:

The first stage was to list all possible benefits from a stricter standard. The next stage was to quantify those benefits by crop groups. We then aggregated the benefits on a national level by the existing cropping patterns and calculated the national average benefit for each kind of crop.

Results:

Net benefits of the 9 alternatives are presented in table 1.

Table 1: Net benefits of each of the 9 alternatives (cents per m^3)*

Salinity				
High	**Intermediate**	**Basic**		
2.8	3	0	**Basic**	**Sanitary**
12.7	**12.9**	9.9	**Intermediate**	
11	11.2	8.2	**High**	

* The values presented in the table represent the added net benefit from moving from the existing, basic alternative (for both the salinity and sanitary groups) to any of the other alternatives.

As can be seen from the table, the preferred alternative is the intermediate scenario for both criterions, sanitary and salinity. The net benefit is 12.9 cents per cubic meter of water. It is clearly more efficient than the existing ongoing costs of desalination (about 60 cents per cubic meter).

These estimates are based on a national average and thus an even higher net benefit could probably be attained once regional differences are taken in account. This issue remains for further analysis.