

The study addressed itself to all kinds of wastes—gaseous, liquid, and solid. Such an application is necessary if we are to arrive at the best total solution to the problem throughout the country.

The Committee on Pollution of the National Academy of Sciences—National Research Council states in a report, "Waste Management and Control":

The difficult job of determining an optimum balance of competing requirements must be approached from a systems point of view. The systems approach must consider the interrelationship of land, air, and water. Too often municipalities get rid of solid wastes by incomplete burning, which may solve land disposal problems, but fouls the air. We must consider the assimilative capacity of water, air, and land taken together as a single entity and in relation to the plants and animals that live there.

The assimilative capacities vary with such factors as the tidal flushing of bays, the flow of rivers and the windiness of locality.

Now, in this first attempt to apply systems analysis to waste management problems in California we found our efforts hindered by inadequate definition of environmental objectives, the lack of pertinent data and lack of generalized analytical models.

However, we could readily identify sources of agricultural, industrial and domestic wastes, and it was clear that by redesign of existing plants, control of design of future plants, development of special waste disposal systems, much of the effluent and residues of California industry and agriculture could be eliminated or rendered less noxious. But at what permissible cost, and over what time period, and by what means of administration and control, and, perhaps most important of all, to what degree?

These questions are not easy to find the answers to. Our studies showed that if we used the existing systems of waste management, merely continuing present methods and expanding these methods to cope with greater demands we see in the future, the annual cost in the year 1990 of treating industrial wastes, commuting greater distances on superclogged superhighways, refurbishing facilities and residences that have been deteriorated by polluted environment will be approximately \$8 billion annually.

Systems engineers making use of improvements possible with today's technology or potential improvements from advanced technology, would reduce the approximate annual cost, we figured, in 1990 to \$3 to \$4 billion. So that is a substantial reduction. It is about equal to the current California State budget.

To evaluate the utility of regional models, the Sacramento area was studied in some detail and simplified and experimental simulation models for digital computers were constructed to predict air quality conditions and to locate sewage treatment plants and scale them for size.

From this and other work we concluded that modeling techniques are well enough advanced to apply to a large region to get better demonstration of the usefulness of the systems approach.

The major conclusions of our study were:

First, that in light of estimated compositions and quantities of waste in the next 25 to 30 years, the continued substantial degradation of environment will occur if present waste management practices are continued.