

tion . . . means the city can avoid the addition of costly treatment facilities. The operation and maintenance costs for wastewater reclamation have proven to be significantly less than full tertiary treatment. On the basis of a 20-year life, the city would pay approximately \$430,000 annually in operation and maintenance costs for land irrigation as compared with approximately \$935,000 for tertiary treatment."

Supplying effluent for irrigation may have two other beneficial effects in Sonoma County. The increased agricultural production resulting from irrigation would be reflected in the general economic activity of the area. Also, irrigation would result in productive open space near or adjacent to urban areas.

Although irrigation with treated wastewater clearly may have economic and other benefits for cities and sanitation districts, the question of potential benefits to agriculture must be considered separately.

Questions relating to effluent use by farmers in Sonoma County include: (1) economics of growing a second crop; (2) long-term effects on soil; (3) public health restrictions on use of effluent; (4) possible toxic elements in wastewater; and (5) value of nutrients in effluent for plant growth.

Much of Sonoma County has only

limited experience with summer irrigation, because most of the open land is planted to winter forage crops supported by winter rainfall. Summer crop production also is limited by the prevailing clay soils and the low summer temperatures resulting from intrusion of marine fog.

The economics of growing a second crop in Sonoma County vary from ranch to ranch. It appears that local dairymen probably have the most to gain, by producing their own forage instead of buying it. The largest cash investment would be in an irrigation system. Projected costs are available from a 52-acre study completed for the City of Petaluma in 1976 by the author and Dan Silacci, a local dairyman. This project was funded by the Sonoma County board of supervisors.

Only minor changes in soil chemistry were observed over the three-year test period. These included a slight increase in the total salts as indicated by the soil conductivity, a change in soil pH from slightly acid to nearly neutral, and a gradual increase in the phosphorus content of the soil.

A major problem on the heavy clay soils will be compaction resulting from necessary cultural operation when soils are at or near field capacity. (This is not an effect of the use of effluent as such, since most irrigation methods would result in a similar problem.) Lower water

infiltration rates and reduced crop yields may result. However, it was observed that more frequent irrigations with smaller amounts of water per application reduced the effects of soil compaction on corn yields.

The present public health regulations allow the use of secondary-treated effluent on all types of forage crops. There is a restriction on milking dairy cattle being in a field while irrigation is occurring. However, this is good pasture management regardless of the water source.

The presence of elements toxic to plant growth or animal health in effluent appears to be minimal in the wastewater used in Sonoma County, although this may not be true in other areas.

Nearly all of the soils in Sonoma County are deficient in nitrogen, and many soils are also deficient in phosphorus. Irrigation with wastewater can significantly reduce fertilizer costs in the production of forage crops.

These studies were concerned primarily with forage crops. A farmer producing high-value food crops should examine public health restrictions very carefully before deciding to utilize wastewater for irrigation.

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Using food-processing wastewater for irrigation

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Food processing in California requires large amounts of water, most of which becomes waste. Since the late 1960s, the major canners, with about 10 plants in the Central Valley, have been irrigating crops with this valuable resource. Many processing plants produce 2 to 4 million gallons per day of effluent during the summer irrigation season. This is sufficient water to irrigate 400 to 800 acres of cropland at each site.

Monitoring of the effluent quality and its effect on crops and soils was begun in 1970, following the enactment of the California Porter-Cologne Clean Water Act. Since then, cooperative research involving the processors, Regional Water Resources Control Boards, and U.C. Cooperative Extension has shown that irrigation is a practical alternative to conventional treatment and evaporation ponds or to discharge to local streams.

The problem constituents in food processing wastewater are:

■ Added nutrients (nitrogen and phosphorus). However, nutrients can be used by plants to produce food and fiber.

■ Added salts, including sodium

and other elements contributing to total dissolved solids (TDS). In general, salinity is increased about twofold during food processing. Occasionally, sodium concentrations increase enough to become a hazard to soil permeability. In that case, calcium—in the form of gypsum—is metered into the effluent to mitigate the problem.

■ Fruit sugar resulting in biochemical oxygen demand (BOD). Elevated oxygen demand can occur with high-sugar fruits. However, odors and anaerobic soil conditions may be controlled by very shallow irrigation or by cultivation within three to four days after the effluent goes onto the soil.

Assuming most crops in California's Central Valley require 40 to 48 inches of water annually, between 180 and 225 acres are needed for each 1 million gallons per day of wastewater effluent during the processing season. For that reason, acreage requirements are large for proper irrigation management and total usage of processing effluent.

The key to use of processing wastewater has been (1) careful monitoring of

effluent quality, (2) making management adjustments for water quality problems, and (3) sound irrigation principles. A normal irrigation season is 120 to 150 days. The food-processing season usually covers most of this time.

Crops that have been successfully grown with cannery wastewater include pasture grasses, alfalfa, sorghum, barley, oats, and grapes. These crops have yielded well, provided good irrigation practices are conducted. Wastewater applications should not exceed crop water requirements plus a reasonable leaching fraction, about 15 percent above crop needs. Deep soil monitoring has shown that agricultural crops use the major portion of added nutrients and that soil permeability has not been adversely affected at any monitoring site. Odors and surface layers of organic matter have not been a problem under proper cultural management.

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