Oster, Meyer, Hermamier, and Kaddah, at the University of California and the U.S. Department of Agriculture Agricultural Research Service, have provided some data on the partitioning of water. In the Imperial Valley, 12 percent of the water diverted becomes deep percolation (leaching water), and runoff (tail water) accounts for 16 percent. In the Coachella Valley, the leaching fraction is somewhat higher, and there is hardly any tail water. Quantitative information from these studies supports the belief that, technically, a reduction in drainage flow is feasible.

Steps have been taken in recent years to initiate water savings and assess the economic consequences of such practices. The federal government finished lining the Coachella Canal in 1981. The Imperial Irrigation District has accelerated its canal lining activities, and it has constructed four off-site reservoirs to provide temporary storage, with plans to construct two more. The District also has established more flexible rules for water orders: instead of receiving a fixed

The UC Mobile Lab monitors water use to help Imperial Valley growers improve irrigation efficiency.

24-hour delivery, an irrigator now can request a reduction in delivery as late as noon of each day and limited changes up to 3:00 p.m. during the final delivery day. Research workers from the Agricultural Research Service are investigating the substitution of drainage water (with 3,000 mg/L salt) for part of the irrigation water and are assessing the potential for "dead level" surface irrigation to eliminate tail water.

The University of California operates a "Mobile Lab" with instruments and equipment, working from the Imperial County Cooperative Extension office in El Centro, to monitor water use and suggest ways to improve irrigation effectiveness. Trained personnel take the lab into the fields of cooperating farmers, where they measure tail water. They also check soil moisture status with neutron probes and recommend irrigation scheduling programs. Measurements in 1983 showed that tail water was noticeably reduced from that observed in earlier years. This reduction was attributed to greater awareness of the problems associated with excessive water use, together with increased off-canal storage and more flexible delivery policies by the irrigation district.

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Case history: San Joaquin Valley

Louis A. Beck

Most of the San Joaquin Valley has been farmed in one fashion or another for more than a hundred years The Valley trough was generally dry-farmed until deep-well turbine pumps were developed in the 1930s and 1940s and irrigation became common. Even though much of the land was in production, it was not irrigated every year: there was some pattern of rotation, such as dry-farming for one year, irrigation for two, and fallow for one. Now, almost 5 million acres of agricultural land on the Valley floor are irrigated.

The Valley, about 250 miles long and 50 miles wide, consists of two drainage basins: the northerly San Joaquin Basin, which drains to the San Joaquin River and then to the Sacramento-San Joaquin River Delta and San Francisco Bay; and the southerly Tulare Basin, which normally has no outlet.

Salinity problems in the San Joaquin Valley have adversely affected almost 600,000 acres of agricultural land now in production. Perched saline groundwater within 5 feet of the soil surface causes a loss of 10 percent or more in annual crop production.

This perched water can be controlled by the installation of tile drains — a system of perforated pipes 6 to 8 feet belowground that keep the water level below the root zone. The drains conduct the water to a corner of the field, where it is discharged to a disposal system.

The perched water in the Valley trough is saline, ranging from 3,000 to 25,000 mg/L of total dissolved solids. In other areas where the perched water is not saline, it can be used for irrigation or discharged to watercourses. Saline water must be disposed of so that it does not affect surface or groundwater. It is the lack of safe disposal systems, areas, or methods that causes the drainage problem in the trough of the San Joaquin Valley. The problem area is expected to exceed 1 million acres within the next 50 years.

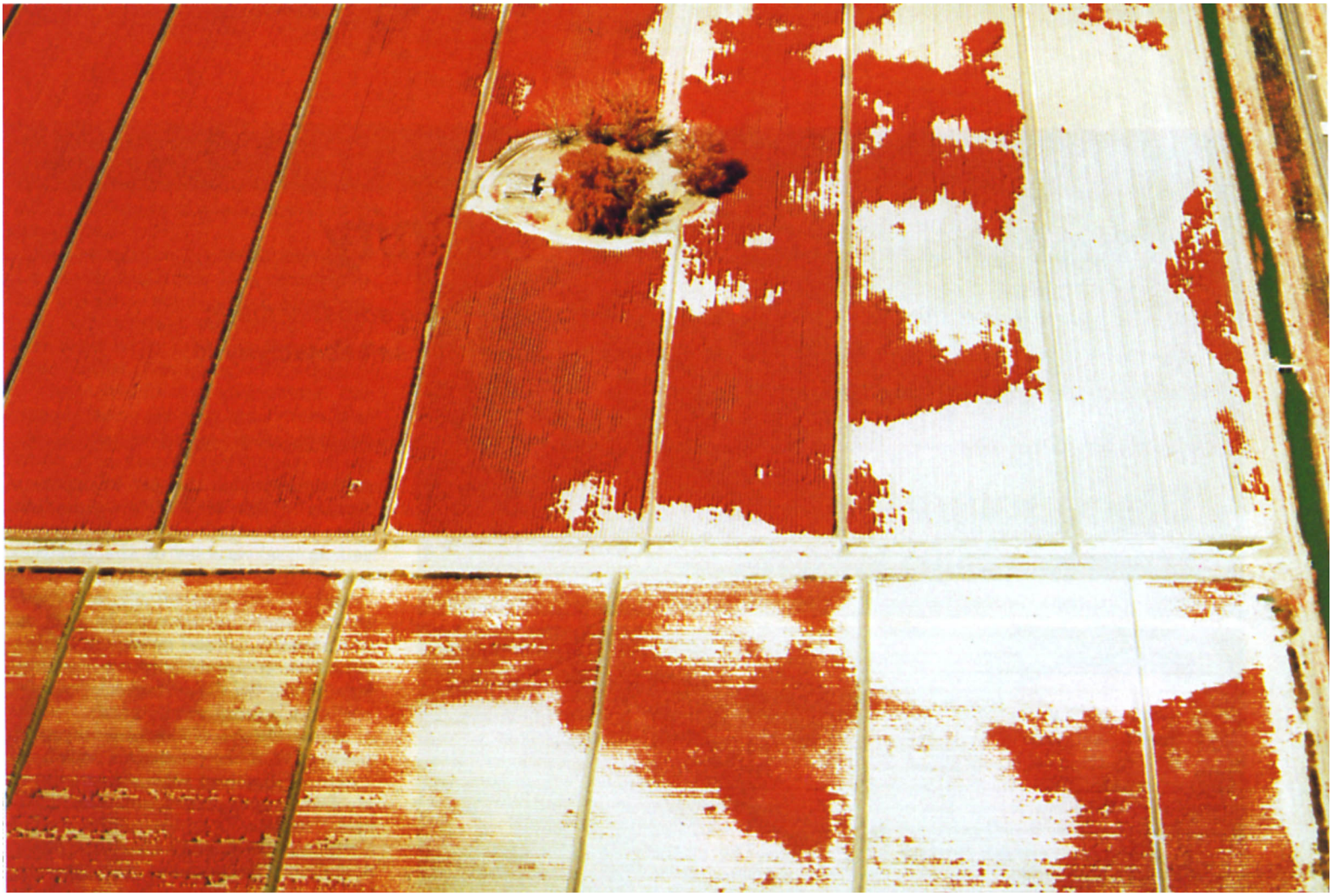
Development of the problem

The drainage problem became serious in the Valley when a full water supply was assured. In the northern area (essentially within the San Joaquin Basin), problems began about a decade after the Delta-Mendota Canal was built and started to deliver water in about 1950. During the 1960s, tile drain systems were installed to allow farmers to continue normal production. Most of the water from these systems is discharged to the San Joaquin River. Because of the relatively small volume and the dilution in the river, discharge of drainage water causes only slight degradation of the quality of the river and minor changes in agricultural practices.

A water supply to the Tulare Basin was guaranteed when the California Aqueduct started delivering water to the San Luis service area of the federal Central Valley Project and to the State Water Project service area in 1968. Drainage problems began by the end of the 1970s. Now several agencies are starting to implement local interim solutions to solve their drainage disposal problems; drain tile will not help, since there is no river to discharge to or any other system to carry the drainage waters away.

Solution

It was proposed during the 1960s that the state and federal governments together construct drainage disposal facilities that would serve the entire Valley



from Bakersfield to the Delta. Studies indicated that the best means of disposal would be the San Joaquin Master Drain, a gravity canal that would discharge to the San Joaquin River near Antioch, but this was not implemented. The portion of the San Luis Drain that has been constructed by the federal government discharges into a small evaporation basin north of Los Banos — Kesterson Reservoir — the capacity of which limits the area served by the Drain to less than 10,000 acres.

Members of the Interagency Drainage Program, formed in 1976, viewed the salt component as a waste and the water component as a resource, and investigated methods of reuse before disposal. Of the five alternatives for disposal (no action, evaporation within the Valley, discharge to the San Joaquin River, discharge to the Pacific Ocean, and discharge to the Western Delta) the recommended solution was the gravity-flow, concrete-lined canal (the Valley Drain) from Bakersfield to Suisun Bay with waterfowl marshes within the Valley to delay the discharge peak from summer to winter and spring. Moving the discharge location from Antioch to Pittsburg was proposed to prevent adverse effects on the Delta.

Implementation of a solution has always been difficult. First, there were technical problems related to possible adverse effects of drainage water on receiving waters, caused by salinity, pesticides or other agricultural chemicals, and nutrients that might produce undesirable growth. Numerous studies by the California Department of Water Resources and by participants in the San Joaquin Valley Interagency Drainage Program have indicated that the technical problems can be handled by location of discharge, dilution, time of discharge, and/or treatment.

The second difficulty is the expense of constructing drainage facilities. Although it could be argued that the benefits to agriculture would exceed the estimated cost of about $1 billion for the Valley Drain and marshes, the question of who should pay and how much have never been resolved.

The biggest obstacle to implementation will be political. Even though technical studies indicate that the potential adverse effects can be prevented, members of the public in the vicinity of any proposed discharge have expressed apprehension that unknown constituents may cause problems in the future. The U.S. Bureau of Reclamation is now conducting studies to provide the State Water Resources Control Board with the necessary information to set discharge requirements for drainage water into the western Delta. The Board is expected to be able to make a decision before 1986, after which a political determination will be made as to whether or not a drainage facility can be constructed that will satisfy the concerns of the public.

A salted-out cotton field in the San Joaquin Valley near Stratford, California, as shown in a color infrared photograph. Below: Evaporating irrigation water wicks salt to the soil surface.

W.E. Wildman

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