Agriculture in the Sacramento-San Joaquin Delta

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The Sacramento-San Joaquin Delta is the water crossroads of California. The state's two longest rivers, in addition to two smaller ones, meet in the Delta 50 miles northeast of San Francisco. These streams drain watersheds constituting more than one-third of California's area.

This triangular area is truly an inland delta, hemmed in by the Montezuma Hills to the north and the Diablo Range to the south, and connected to salt water in San Francisco Bay by a narrow strait. Bordering the Delta region are Sacramento, Stockton, Tracy, and Antioch.

The actual Delta encompasses an area of about three-fourths of a million acres, of which approximately 550,000 acres are cultivated. Delta soils range in composition from predominantly organic (peatland) to mostly mineral. Nearly 150,000 acres can be considered true peatland. These unique lands are protected from reverting to their original swamp state by 1,100 miles of levees.

Delta soil is a vast and rich agricultural resource, which in combination with mild climate and abundant, good quality water, has the capacity to produce outstanding yields. However, problems with flooding, fire, salt water intrusion and salinity control, soil subsidence, channel alluviation, and decreased water flows often seem to negate those natural advantages.

Unaltered peat is a dark, coarse, fibrous material which may be as high as 80 percent organic matter. The remains of tules predominate in the upper zone, generally to about 3 feet down, and fibrous reed remnants (buckskin) compose the bulk of the lower strata. The organic matter content and depth decrease as the Delta margins are approached. Peatlands occur as deep as 40 feet in the interior portion of the Delta, but more typically are only several feet thick. Near the Delta margins the peat may be shallow or nonexistent. These acidic, organic soils have a high water-holding capacity and are very permeable. Underlying the peat is a comparatively impervious light-gray or light-bluish mineral substratum.

The early years

Prior to the fervor produced by the discovery of gold in California, activity in the Delta by non-Indians was limited to occasional excursions by trappers and Mexican soldiers. The Gold Rush ushered in an era that opened the 700-mile maze of waterways from San Francisco to Stockton and Sacramento. At that time, the swamp and overflowed lands had little or no resource function. By 1850, settlement began to follow the line of higher elevation along the natural levees where deep water access, firm ground, and timber were available. Over time, settlers extended their reach on the swamp lands through the use of small levees (many as low as one foot), designed primarily to retard tidal action.

Upon the acquisiton of California, the United States became proprietor of all lands owned by the Mexican government, including the vast majority of Delta lands. The Arkansas or Swampland Act of 1850 gave opportunity to certain states to gain title to swampland areas on the condition that the proceeds of the sale of such lands would be used in their reclamation. Of the more than 2 million acres received by the State of California, 500,000 were in the Sacramento-San Joaquin Delta. In 1855, the California State Legislature passed an act to provide for sale of swamp and overflowed lands to individuals. There were attempts to organize reclamation districts under the control of the state and county to reclaim the swamplands, but most of the reclamation was done by private individuals or groups. Levees evolved from small mounds of peat and soil a few feet high to massive flat-topped ridges 100 feet wide at the base and 25 to 30 feet high. By the early 1920s, virtually all farmable virgin swampland had been reclaimed.

Reclamation, however, was not a smooth transition from swampland to productive farmland. Many levee designs and levee heights proved inadequate and floods frequently inundated tracts of land, often financially ruining farmers. Frank's Tract, which flooded in 1938, remains under water today because of the expense of reclamation.

Irrigation procedures

Islands or tracts of land were originally irrigated by controlling tide gates at the levee. These gates allowed the island to drain at low tide and could be closed at high tide to prevent water inflow. To irrigate, the gates remained open at high tide, allowing the river water to enter the drainage ditches and raise the water table into the root zone of the crop. On the lower islands, and as alluviation and subsidence affected the elevation of the upper islands, the tide gate system worked poorly. Pumps were then installed to rid the tracts and islands of water in order to maintain a 3- to 4-foot dry root zone and the crops were watered by subirrigation. (See page 5.)

Problems in peatlands

Delta peatlands have faced flooding as their major problem since the first levees were constructed in the early 1860s. Approximately 100 levee failures have occurred since 1900—about 35 of them since 1930. Before 1950, most failures were because of overtopping of the levee. Since then, upstream dams have reduced that particular threat. However, levee instability is becoming more prevalent, mainly because of subsidence of the islands' interior land surface and, to a lesser degree, building up of the channels by alluviation. These two factors result in an increasingly unbalanced load on the levees.

Subsidence is primarily the result of peat oxidation, although wind erosion, shrinkage, and compaction may also contribute. Oxidation takes place continually in peat above the water table. It is accelerated by tillage and greatly speeded up by burning of peat fields—a common practice for a period of 60 to 70 years. Typically, soils were burned at 3- to 5-year intervals for the purpose of controlling weeds and other pests. Each burn commonly oxidized 3 to 5 inches of peat soil. Today this practice is avoided, but peat fires are still a threat when accidentally started by careless stubble burning, faulty exhausts, or careless travelers.

The first methodical investigation of subsidence began in 1922. It was found that the most recently reclaimed peatland suffered the greatest rate of subsidence. The average annual subsidence was nearly one-fourth of a foot per year.

Wind erosion also plays a part in lowering the surface of peat soils. Light, dry peat soils are easily carried by winds considerable distances. Measurements have revealed, however, that less than one-eighth inch of peat soil is typically eroded each year by winds.

Sediment brought in by water and deposited on the channel bottom results in increased channel elevation in relation to adjacent island as described before. This process of alluviation increases the chance of levee failure.

Seasonal water flow diminishes in late summer, although in normal rainfall years Delta outflow is sufficient to retard salt water intrusion from Suisun Bay. The exception is during "dry" and "critical" years when low river flow enables the salt water to penetrate the western Delta islands, causing damage to crops when used for irrigation. Salt accumulation in the root zone is another hazard where subsurface irrigation is practiced in peat soils. (See article on page 10.) As a result of the constant threat of salinity, only proper management and good water quality can sustain yields.

Although the Delta lands were considered a worthless swamp by miners and entrepreneurs of the Gold Rush era, men of determination have transformed them into a vast agricultural and recreational paradise. Farmers have long faced recurring problems of flood, fire, and the continual pressure of subsidence. Today, they are facing new challenges concerning the quantity and quality of water allowed to pass through the Delta waterways. These new pressures on the Delta may require new changes and will, no doubt, add another colorful chapter to its history.

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Subirrigation in the Delta

The peatlands of the Sacramento-San Joaquin Delta are irrigated almost entirely by subsurface methods. Gravity surface irrigation is not suited to these organic soils because of high infiltration rates and variable subsidence which makes surface distribution difficult. Sprinkler irrigation is an alternative, but is not widely used because of the high capital outlay and high energy costs.

In a typical Delta subirrigation system, water from the river channel is siphoned over the levee and into a system of unlined head ditches and small lateral ditches ("spud ditches") cut into the peat soil. Spud ditches are 6 inches wide, from 10 to 24 inches deep and are commonly spaced from 40 to 80 feet apart. (See illustration.)

Several times during each irrigation season, the spud ditches are filled. This quickly raises the water table in the porous peat soil from a depth of 3 or 4 feet to within 6 to 10 inches of the surface. Water stored in the root zone, which in peat may be as much as 6 inches per foot of soil, is then depleted by the crop and by evaporation from the soil surface. As a result, the water table gradually drops until irrigation is necessary again.

Drainage is provided by larger and deeper ditches cut from 300 to 1,000 feet apart. These are connected to a main drain, 7 to 10 feet deep, through which water flows to a pump and is returned to the river.

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