

Ground-water Overdraft

balance between recharge and draft on ground-water required to correct overdraft in Antelope Valley

J. Herbert Snyder

The following article is the third and final part of a series based on the detailed report Ground-Water Overdraft in Antelope Valley—Ground Water Studies No. 2, to be issued by the Giannini Foundation, 207 Giannini Hall, University of California, Berkeley 4.

Fixed charges for typical water pumping plants in the Antelope Valley increased nearly fourfold from 1925 to 1952, but the improved quality of wells and of pumping plants—during that period—tended to offset the cost increases.

Typical variable annual pumping costs in the same period have remained nearly constant or have decreased because of declines in power rate schedules and greater efficiency of the pumping plants.

Variable costs for pumping in 1925 amounted to \$3.50 per acre-foot to pump 1,200 acre-feet of water from a depth of 100 feet. In 1952 the same volume of water pumped from a depth of 200 feet cost between \$2.50 and \$3.65 per acre-foot—depending upon the particular rate schedule used. An improvement of 10% in over-all pumping efficiency permitted pumping—at the same cost—from a depth 50–75 feet greater than before the improvement in efficiency.

The number and size of pumping plants—used to supply water requirements of a particular farm—will affect pumping costs and the character of the ground-water resource. The character of the resource is such that, theoretically at least, one large deep well or several smaller wells might supply a farm's irrigation needs.

If a 160-acre farm requires 5 acre-feet per acre per year, this can be supplied by four 450 g.p.m.—gallons per minute—pumping units and 500-foot wells or one 1,800 g.p.m. unit on a 1,000-foot well. Assuming a 250-foot total pumping lift, fixed pumping costs were \$3.38 and variable costs were \$5.48 for the 450 g.p.m. units—a total of \$8.86—per acre-foot in 1952. For the 1,800 g.p.m. unit the 1952 fixed pumping costs were \$2.46 and the variable costs were \$3.04—a total of \$5.46—per acre-foot. This cost differential also permits pumping from greater depths at lower cost if the large unit is used.

Both fixed and variable costs have influenced the shift from a large number of small pumps to a relatively smaller number of large pumps, which is reflected by the increase in the average acreage per pump in the Valley.

Another shift—from diesel and gasoline to electrically powered pumping units—occurred after 1930 because of reductions in electrical energy charges. Substantial economies of scale accrue to the user of electrical energy because of the block-system of power charges. Also, costs of repairs, lubricants, and attendance are reduced.

Increasing the amount of irrigation applied to alfalfa in the Valley affects the marginal—added—cost of water enough to permit decreased costs per acre-foot pumped. Associated increases in yield as the water application is increased may be sufficient to raise net farm income.

Substantiating this relationship between decreasing costs and increasing yields with increased water application would establish a clear-cut conflict between conservation of the ground-water resource and economic utilization of that resource. For example, minimum water requirements for alfalfa may be specified at five acre-feet but cost-price-yield relationships may nevertheless cause the use of six or seven acre-feet per acre per year.

In spite of overdraft of the ground-water resource, the Valley has continued agricultural expansion and intensified the overdraft. So far, technological improvements have kept slightly ahead of the otherwise increasing costs associated with a falling water table. The result has been the mining—the removal in excess of recharge—of the ground-water stock resource.

In dollar and cent terms, the Valley farmers have profited from the mining of the water resource. It has been estimated that if the ground-water stock had been used at a safe yield rate—draft-recharge—and exclusively for alfalfa production, the net profit from alfalfa for the period 1927–1950 would have been less than \$5,000,000. Actually, net profit to alfalfa farmers in the Valley, for the period 1947–1950 alone, was about \$4,500,000. Thus short-term or long-term income generated by mining the ground-water stock resource may easily exceed a long-term average annual income resulting from maintaining

approximate balance between recharge and draft.

Alfalfa has become the principal irrigated crop in the Valley. It accounted for approximately 75% of the Valley's total 1953 income from plant crops and about 80% of the net draft on ground-water.

On the average, the Valley farmer received greater net returns per acre returns from alfalfa than from most other crops popular in the area. Dependent upon the level of management and projection of 1946–1951 cost-price relationships—representing typical 160-acre operations—alfalfa will return the greater positive management income until total pumping lifts exceed 350–450 feet. A 40- or 80-acre farm with pumping plants too small to provide adequate water for alfalfa—as pumping lifts approach 250'—will probably find field corn a more profitable alternative. Overdraft may be expected to continue until total pumping lifts associated with 120–160-acre farms or larger—pumping at rates greater than 1,400 g.p.m.—exceed the 500-foot level.

Projecting 1946–1951 cost-price relations suggests these economic limits of pumping for Antelope Valley may not be reached for another 35 to 65 years—

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William F. Calkins.....*Manager*
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depending upon the rate of expansion of water use in the Valley.

In the last 10 to 15 years, Valley water users have realized the seriousness of the overdraft situation, but only small gains have been made toward a solution to the problem.

Recharge volumes of water available in the Valley each year are not sufficient to support intensively cultivated irrigated agriculture at even one third the present acreage levels.

Zoning ordinances to protect and promote certain types of land use and to restrict other types to conserve the ground-water stock resource may be feasible for the Valley, but even if such ordinances were adopted, water levels would continue their decline although at slower rates.

Los Angeles County did attempt to zone the Valley to prevent the drilling of new wells in 1944. The ordinance was a temporary urgency measure designed to prevent additional overdraft while a comprehensive land use or conservation plan could be prepared. Public pressure and the insecure legal basis of the ordinance combined to effect its repeal after only a year's enforcement. No reduction in overdraft was observed during this period. No subsequent action has taken place.

A new experiment in the fight against overdraft originated in the Orange County Water District in 1953. Passage of legislation permits both an ad valorem property tax and an annual pumping levy to be used to buy water from the Metropolitan Water District and use it to recharge the depleted ground-water reservoir. The tax and levy structure is designed to protect nonfarm property owners from subsidizing payments for water necessary to eliminate annual overdraft induced by farmers. The cost of this program is within reasonable range for the individual farmer, and payment is in proportion to the amount of ground-water used.

With certain modifications, a similar plan could be adopted for use in Antelope Valley, provided a firm water supply was available at prices Valley farmers could afford. Specific measures to combat overdraft may be seriously hampered by initial resource imbalance and economic pressures dictating resource depletion rather than conservation.

Without some effective plan to import additional water, the ground-water stock of the Valley can be conserved, but overdraft will continue.

Barring imported water, long-run overdraft will continue in Antelope Valley until economic pressures force a balance between recharge and draft.

J. Herbert Snyder is Instructor in Agricultural Economics, University of California, Davis.

California Insects

survey provides accurate data for study of state's insect problems

Paul D. Hurd, Jr.

Insects of economic importance in California—whether native or introduced—have often been studied with almost complete disregard for their relationship to other insect species, largely because of the immediacy of a specific problem.

However, exploration by entomologists of the central problem of biology—the mechanism of evolution—has demonstrated that there are a number of general underlying principles to be obtained from an analytical study of related insect species. These studies, while still too few, have shown that an organism is able to live—or thrive—only in portions of the total environment where it can meet the requirements of its livelihood. There are, however, many instances where insect species are able to survive in artificially created environments—such as those insects, for example, which have developed resistance to DDT.

California—because of its geographic location and topographic diversity—contains several districts with definite differences in their insect populations. Some of the insects are more important, economically, than others. However, there is no assurance that one group of insects will not become economically important as the environmental conditions of another group of insects undergo change.

The motivating reason for undertaking an insect survey in California by the University of California was to make known the relationships among insect species so that problems relating to agriculture, forestry—and medicine—within or adjacent to the State may be approached from a fundamental and realistic viewpoint.

The objectives of the insect survey in California are: 1, to critically explore the extent and nature of insect life of California; 2, to obtain information on the geographic ranges, distributions, and ecologies—environmental conditions—of California insects; 3, to maintain a research-survey collection which will reflect the nature of California insect life and provide the basis for analytical and evaluational studies; and 4, to make this information readily available to researchers working on associated agricultural problems.

From 1940 to 1947, survey activities centered about the accumulation of insect specimens, with data from various districts of California. Since 1947, a basic research collection in the principal orders of insects has been available to and used by specialists in institutional, state, and federal agencies.

Considerable additional information is needed on the distribution and ecologies of California insects to clarify some of the problems of identification, distribution, host relationships, economic importance, and other related problems.

Paul D. Hurd, Jr., is Junior Entomologist, University of California, Berkeley.

The above progress report is based on Research Project No. 1205.

The Bulletin of the California Insect Survey, containing detailed information on the distribution and ecology of insects in California, is available by addressing a request to the Department of Entomology, University of California.

Map showing distribution of insects attacking forest products—shaded areas—and of insects attacking other commercial crops—white areas.

