there will be just as many mosquitoes as there are today.

This can be predicted: If the State Legislature meeting in 1953 follows the recommendations of the State Board of Health, by 1960 a very marked reduction in salt marsh mosquito population should be evident along the coastal areas of the state.

Perhaps some new, effective and economical weapon for mosquito control will be found. We hope so. But, until it is, the State of Florida once again will employ fundamental control, supplemented by larviciding and adulticiding. Florida mosquito controllers don't want to be caught again uselessly using DDT against DDT resistant salt marsh mosquitoes.

The entire coastal area of Florida is covered by mosquito control districts, broken only in two places—one on the East Coast by Flagler County, and one on the West Coast by Charlotte County. It is believed that, by 1953, these two Counties will have voted to establish districts.

THE MOSQUITO SOURCE REDUCTION PROGRAM OF THE MERCED COUNTY MOSQUITO ABATEMENT DISTRICT

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The Merced County Mosquito Abatement District was organized in 1923 as a 17-square-mile district to do malaria mosquito control in and around the city of Merced. In order to control the pest field mosquitoes (*Aedes dorsalis* and *Aedes nigromaculis*) the district was expanded to 90 square miles in 1940. As a result of a tremendous increase in the acreage of land under irrigation, particularly irrigated pastures, the *Aedes sp.* problem became increasingly severe throughout the county in the period from 1935 through 1945. The acreage of irrigated pasture increased in this same period from 300 acres to 28,000 acres. As a result of this increased mosquito problem combined with the threat of the introduction of mosquito-borne diseases by returning veterans from the tropics and the prospect of financial aid from the proposed California State Subvention program, the district was expanded to a county-wide basis of 1,995 square miles in 1945.

At the present time about 1,400 to 1,500 square miles of the county are under irrigation and hence pose a mosquito problem. At least 70% of the problem results from irrigation water in one way or another. There is some mosquito production in the irrigation facilities such as canals, ditches and drains, but by far the largest source of mosquitoes is in the irrigated fields themselves. As indicated above, irrigated pasture is the most consistent producer of mosquitoes, but any irrigated crop can and does produce mosquitoes when and if water stands long enough (3 to 5 days in mid-summer heat). This would include 250,000 acres of wild pasture much of which is irrigated sporadically by uncontrolled flooding; 100,000 acres of alfalfa; 70,000 acres of barley; 40,000 acres of cotton, and 7,000 acres of rice as well as smaller acreages of tomatoes, beans, corn, sugar beets, orchards and vineyards.

In some cases mosquitoes are produced in irrigated fields as a result of carelessness or ignorance on the part of the farmer. However, in many cases excess water is left standing for a variety of reasons beyond the control of the farmer. This subject has been well covered by Lloyd Myers, who was assigned to Cali-

fornia from the Public Health Service, in a paper on "The Relationship of Agricultural Drainage to Mosquito Control Drainage" to be published in the Proceedings of the California Mosquito Control Association for 1952. In most cases the farmer himself wants to avoid excess standing water on his crops and is also anxious to get rid of it once it is standing, as he knows that it will harm his crops in all cases, except rice.

According to California law the property owner who is producing mosquitoes is legally responsible for maintaining a public nuisance which can be abated by due process of law. California districts have seldom made use of the provisions of this law and then only as a last resort. Three of the policies adopted by the Board of Trustees of the Merced County Mosquito Abatement District in December 1949 illustrate the attitude of the district on this matter and serve to guide its mosquito source reduction program. They are as follows:

I. The primary objective of the District shall be the progressive elimination of mosquito breeding places through education, persuasion and cooperation.

II. Stress will be given to cooperation with individuals and organizations to solve mutual problems involving production of mosquitoes. Particular attention will be paid to water management, irrigation and drainage problems and household and industrial waste disposal.

III. In cases where cost of temporary control is prohibitive and when all means of eliminating the source fail, the District will take the necessary steps to abate the nuisance when such action appears to be in the public interest.

The Merced County Mosquito Abatement District approaches the problem of eliminating or reducing mosquito sources from several different angles.

First is a public relations and education program designed to acquaint the public with the "facts of life" in regard to mosquitoes, with special emphasis on what the individual can do to avoid production of mosquitoes or to correct existing situations leading to mosquito production. This includes a systematic attempt to inform the farmers of the advantages of drainage and to point out the help obtainable in solving drainage problems through the mosquito district and other agencies. The public relations and education program starts with every employee of the District as they are all required to be able to discuss the District's program intelligently with anyone. However, it is the operators and the foremen who do the bulk of the contact work with individual farmers. The subjects of mosquito control and drainage are covered in the annual illustrated talks given to the grammar schools and high schools throughout the county. Special talks on the source reduction program of the District are given to service clubs, farmers' organizations, etc. News releases and feature articles have amply covered the District's work.

Second is the matter of cooperation with other agencies to the mutual advantage of all concerned, including the farmer. A year ago the Mosquito District took the initiative in organizing the Merced County Water Conservation Committee. Membership of this group includes about thirty-five organizations concerned with water problems in the county such as the irrigation districts, canal companies, drainage districts, soil conservation districts, County Health Department, County Road Department, County Planning Commission, U. S. Bureau of Reclamation, California State Department of Fish and Game, Calif. State Department of Public Health, local sportsmen's associations, etc.

The Committee has set up working subcommittees on the following subjects: Water Pollution and Contamination, Watershed Improvement and Low Water Table Problems, Drainage and High Water Table Problems, Irrigation Practices, Flood Control, Water Management for Attracting Ducks, and Public Information. The Mosquito District is vitally interested in all of these problems and has taken an active part in the work of the Committee. I was elected as Chair-

man of the entire Committee for its first year and am now Secretary. Cooperation and understanding among the member agencies has improved considerably in the short time of the existence of the Committee. The working sub-committee on drainage has attempted to coordinate work on drainage being done by the various member organizations. This has greatly facilitated cooperation. The Merced County Mosquito Abatement District has received excellent cooperation on drainage projects from the Merced County Road Department, the Merced Irrigation District and the Soil Conservation District at Los Banos.

Third is the actual performance of the drainage work (at cost or less) as an aid to the individual farmers concerned and as a demonstration for other farmers to see. It would appear to be obvious that any type of drainage which removes standing water from a field or roadside and carries it to a drainage channel or natural stream is of necessity performing a mosquito source reduction function. At any rate this assumption is the basis for the policy and practice of the Merced County Mosquito Abatement District in regard to "permanent" or "eliminative" control in irrigated areas which we prefer to call mosquito source reduction.

The Merced County Mosquito Abatement District is in its third year of a drainage promotion program. At present the District owns and operates a Fordson tractor and ditcher, an Allis Chalmers HD-7 tractor and dozer with two ditchers and a grader and a Link-Belt Dragline with ½ yard bucket. All of this equipment is handled in the same way. Individual farmers or groups of farmers contract with the District to have drainage construction or maintenance work performed. The District enters into such agreements only when such work will eliminate or reduce an actual or potential mosquito hazard as shown by the District records; specifically the inspection treatment record card and the section survey map sheet. These cooperative drainage projects may involve only one farmer or they may involve as many as twenty or more property owners. Most of the projects carried out by the District so far have involved installation of drainage systems in irrigated pastures. These are usually designed to carry off the excess irrigation water at the lower end of the checks to a drainage channel where mosquito larvae can be eaten by fish or can be easily sprayed if necessary. This type of drainage is also highly beneficial to the farmer. The farmer's attitude, after successful completion of a project of this kind, is exemplified by the statement made by Mr. Elmer Murchie, Manager of the Crocker-Huffman Land & Cattle Company of Merced. Mr. Murchie credited the Merced County Mosquito Abatement District's drainage program with three positive benefits to them. (1) Relative absence of mosquitoes in the area with drainage systems making it possible for irrigators to work and cattle to eat unmolested. (2) Increased yield of pasture grass. (3) Consequent increase in the weight of beef cattle.

In addition to contracting with the farmer to do the drainage work at cost, the Mosquito District helps the farmer in other ways. Some of the projects are promoted by the District on its own initiative while others are requested by farmers, but in both cases District personnel perform the "leg-work" necessary to get the interest of all the property owners involved. The District sponsors meetings of such groups and provides free legal and engineering advice. Any surveying necessary is done by the District with no charge. If hand work is needed the District provides a crew of rehabilitation center labor with no charge. If easements are needed the District handles the negotiations. If concessions are needed from other governmental agencies the District makes the arrangements. All in all the Merced County Mosquito Abatement District is making drainage available to the farmers at a very low cost.

This type of drainage program reduces the area requiring spraying in some indi-

vidual pastures by as much as 90%. It means that operators, instead of having to spray entire fields, spray only a few residual drains in the field.

The following case histories of actual cooperative drainage projects performed by the District with the tractor and ditcher are typical of the results obtained so far.

	Pasture	Larviciding Cost for One Season	Cost to District for Drainage	Larviciding Cost Following Season
Case A	1,200 Acres	$1,275	$81	$295
Case B	100 Acres	$ 201	$52	$ 19
Case C	33 Acres	$ 29	$11	$ 0

These projects obviously result in a financial saving to the district, but they also mean increased yield to the farmer and consequently increased good will for the district.

We regard our program as a long range approach and our individual projects as demonstrations of what can be done. We realize that there is more to be done by way of drainage in Merced County than any one organization without unlimited resources could ever hope to do. Any reduction of mosquitoes through drainage so far is infinitesimal compared to what is left to be done, but it is at any rate a step in the right direction. Further accomplishment in any marked degree will depend in large part on the cooperation obtainable from the farmers themselves as well as from other agencies.

SUMMARY: The Merced County Mosquito Abatement District is approaching the problem of reducing mosquito sources in irrigated fields by contracting with the farmers to do the necessary drainage construction and maintenance work at cost; by cooperating with and enlisting the aid of other agencies with mutual problems; and by conducting an educational program to promote the solution of drainage problems by the farmers themselves.

THE CDC PROGRAM RELATED TO WATER RESOURCES DEVELOPMENT[1]

CHRIS A. HANSEN

I. Introduction. Water is a major factor in Western prosperity. To the members of this Association, water also means mosquitoes, and mosquitoes mean disease, discomfort, and economic loss. We are all interested in this national resource and its development for the greatest benefit to the greatest number of people. This afternoon, I want to tell you the reasons why we, in the Communicable Disease Center, are participating in the national water resources development activity, the problems we face, and the program we are conducting.

II. The National Water Resources Development Program. Development of the nation's water resources has been under way since early colonial times, but only during the past forty years has the magnitude of this development become significant. Federal, state, local, and private groups are all participating in this work, but often with widely divergent interests and needs. To coordinate the efforts of all, the President, in 1948, ap-

[1] From the Communicable Disease Center, Public Health Service, Federal Security Agency, Atlanta, Georgia.