

WATER BALANCE METHODOLOGY FACT SHEET

Background

In May 2007, the California Central Valley Regional Water Quality Control Board (CVRWQCB) adopted Waste Discharge Requirements General Order No. R5-2007-0035 for Existing Milk Cow Dairies (General Order). The General Order imposes significantly more stringent requirements than were previously mandated. This includes an evaluation of existing liquid manure storage ponds based on groundwater monitoring results. While it is recognized that liquid manure storage ponds may contribute to subsurface loading of nutrients and salts via seepage, the magnitude of seepage and its contribution to the overall subsurface loading relative to other sources on dairy farms in California (e.g., livestock housing areas such as corrals and exercise areas, and irrigated, manure-treated agriculture) is unknown. Furthermore, according to university hydrologists, groundwater monitoring data are not suitable to quantify seepage.

Methodology

The water balance accounts for inflow to and outflow from the lagoon and accounts for changes in storage over a given period of time. By avoiding times of precipitation, discharge to the lagoon, and the removal of lagoon water, the seepage rate can be computed as a residual by measuring the decline of the water level and subtracting evaporative losses. Lagoon water level changes are measured on a sub-millimeter scale with high precision pressure transducers. Evaporative losses are computed with a rigorously tested bulk aerodynamic transfer model supported by field measurements of air temperature, relative humidity, wind speed, and the lagoon water surface temperature.

Water balance methodology provides a means to measure very small changes in the water level of a working lagoon with high accuracy, comparative cost effectiveness, quantified statistical confidence, and minimal disturbance to daily dairy operations. If indicated, further investigation of the lagoon may be necessary. A technical field guide, *Protocols for Measuring Dairy Lagoon Seepage Using the Water Balance Method*, was developed as part of this project. The guide is intended to help interested parties carry out field measurements and computations to estimate the water balance of dairy lagoons.

Innovation and benefits of methodology

This project demonstrated the effectiveness, utility, affordability, and usability of the water balance methodology in the field. The innovation of this project is the application of readily available high quality instrumentation to yield highly accurate measurements of changes in the water level of a lagoon. This can be accomplished with quantified statistical confidence and minimal disturbance to daily dairy operations. Water balance approaches have been applied to liquid manure storage ponds in the past. However, these efforts have been characterized by large, often poorly quantified errors

and long measurement periods (several weeks), which made them impractical for application on working dairy farms. This project demonstrated that the water balance method can provide accurate data more quickly and in a manner more cost effective to producers than previous alternatives, provided the lagoons to be measured can be hydraulically isolated.

Cost effectiveness

In early 2011, the equipment necessary to conduct water balance measurements cost approximately \$12,000. An average labor effort of 3 to 5 workdays should be anticipated for conducting measurements on each lagoon, with an average labor effort of 3 to 7 workdays expected for analysis and reporting. Testing of several lagoons in conjunction with consolidated reporting has the potential to reduce costs.

Technical field guide

Protocols for Measuring Dairy Lagoon Seepage Using the Water Balance Method, can be downloaded from <http://www.westernuniteddairymen.com/environmental-mainmenu-34>.

Project partners

California Department of Food and Agriculture, Dairy CARES, East Stanislaus Resource Conservation District, Luhdorff & Scalmanini, UC Davis, and Western United Dairymen

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Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, Environmental Quality Incentives Program funds are used to award competitive grants to non-Federal governmental or nongovernmental organizations, Tribes, or individuals.

CIG enables NRCS to work with other public and private entities to accelerate technology transfer and adoption of promising technologies and approaches to address some of the Nation's most pressing natural resource concerns. CIG will benefit agricultural producers by providing more options for environmental enhancement and compliance with Federal, State, and local regulations. NRCS administers CIG. For further information on CIG, visit <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig>.