FRESNO STATE

California Water Institute

Fresno State Water Showcase

October 20th, 2022

Program

Can Post-Fire Sediment be Used to Restore Hydrological, Geomorphic, and Ecologic Processes of Degraded Meadows in the Southern Sierra Nevada?

By Kate Wilcox, Department of Viticulture and Enology *katelyn_wilcox@mail.fresnostate.edu*
Collaborators: Mara Brady and Chris Pluhar

In collaboration with the Pacific Southwest Research Station Branch of the US Forest Service, the research focus is how to utilize post-fire sediment to fill incised meadow channels and restore the many benefits that meadows provide. Meadows slow flooding flows, filter water, store carbon, and provide important habitat for native species. However, due to land use practices, many of the meadows in the Sierra Nevada are degraded by deep gullies running through them which prevents water from flowing over the meadow floodplain and depositing fine sediment and recharging groundwater. This break in hydrologic processes results in decreased water tables, drier ecosystems, and released carbon. However, a natural solution may exist. As fire severity and size increases in the Sierra Nevada, so does corresponding post-fire erosion. We propose capturing this sediment within the incised meadows by installing semipermeable restoration structures that slow flows and allow aggradation. As the channel fills, we predict that future flooding flows will once again be able spill over the floodplain, slowing, and depositing sediment.

San Joaquin Valley Water Collaborative Action Program

By Elijah Banda, California Water Institute R&E *ebanda@mail.fresnostate.edu*

The San Joaquin Valley Water Collaborative Action Program (CAP) is a bold initiative to develop a "big tent" collaboration in which previous adversaries come together to define a common vision for sustainable water resources management in the San Joaquin Valley. Five diverse interest groups are engaged in the CAP process: 1) safe drinking water and disadvantaged community advocates; 2) environmental NGOs; 3) local government; 4) farmers and the agricultural industry; and 5) water agencies from throughout the Valley. The caucuses work with each other through a carefully designed decision-making process, based on criteria for effective collaboration, to come to agreement on key policy issues. The reliance on collaboration and compromise, rather than on conflict and adversity, allows CAP to promote comprehensive and innovative approaches that can replace non-sustainable water resource policies with sustainable policies to guide the Valley's future.

CAP Phase 1, which is nearing completion, focuses on reaching agreement on common problems and solution set elements to address those problems. Phase 2 will focus on working with federal, state, and local agencies, and others to develop and implement specific actions and policies necessary to achieve the CAP sustainability vision. CAP created five inter-caucus work groups to identify more than 100 actions and policies for implementation. In Phase 2, CAP will modify and prioritize these actions as appropriate and work with local, state, and federal organizations to implement the CAP comprehensive, integrated program for universal safe drinking water and sustainable water resources.

Comparative Yield and Nutritional Quality Between Forage Sorghum and Corn

By Florence Cassel, Center for Irrigation Technology *fcasselss@csufresno.edu*

The research examined the agronomic feasibility of adopting forage sorghum, a drought and salt tolerant crop, as an alternative to corn, in regions of water shortages and marginal soils. Performance parameters, including yield, water and nitrogen use efficiency, as well as nutritional quality, were compared under various irrigation practices and nitrogen fertilizer rates.

Lysimetric Determination of Crop Water Requirements for Sorghum

By Florence Cassel, Center for Irrigation Technology *fcasselss@csufresno.edu*

This research is part of a long-term program aimed at developing new crop water requirements and new crop coefficients for crops grown under drip irrigation in an effort to optimize irrigation efficiency at the field scale. The study presented here focused on sorghum, a crop with lower water demand than traditional forages such as alfalfa and corn extensively grown for the dairy and beef industry.

Use of Bio-Inoculants for Enhancing Salt and Boron Tolerance in Broccoli and Romaine Lettuce Irrigated with Varied Levels of Salinity

By Kaomine Vang, Center for Irrigation Technology *kaominev@csufresno.edu*

California experienced one of its most intense droughts in California history from 2011-2021. With the unavailability of good quality water for irrigated agriculture, growers must consider using alternative sources of water, e.g., drainage water. If saline drainage water reuse is to be considered as a new source of irrigation water, especially under drought conditions, alternative drought and specifically salt and B tolerant crops must be identified or developed. In this regard, the addition of natural occurring microbial strains onto vegetable seed as a form of bio-inoculation, has been proposed to improve a plant's salt tolerance and health when grown under saline conditions. Bio-inoculants entrance occurs via colonization of cracks or fissures naturally available in the epidermic tissue of seeds (crack-entry mechanism). They can promote plant growth by conferring tolerance to abiotic stresses and thereby increase crop yield and quality of crop. In our proposed study, seed from selected varieties of broccoli and Romaine lettuce will be inoculated with bacteria strains commonly found in association with poplar and willow trees. The plants will be irrigated with different salinity salt treatments, including B and Se levels, that are simulated to represent typical levels of saline drainage and ground waters found in the westside of Central California. Plants will be evaluated for salt tolerance, including yield, ion accumulation, and presence or absence of biostress indictors (proline, phenolics). The proposed three-year field project can validate the safe use of native bacteria strains for increasing salt and B tolerance in crops irrigated with saline water. The successful addition of native endophytes to vegetable seed from salt-sensitive Romaine lettuce and moderately salt-tolerant broccoli can confirm that the natural microbiome has endophytic strains that may be able to enhance salt and B tolerance of crops when irrigated with poor water quality.

SGMA Compliance; Spatial and Operational Consistency across SJ Valley GSAs

By Anita Chaudhry, Center for Water and the Environment *achaudhry@csuchico.edu*
Collaborators: Steve Blumenshine and Laura Ramos

The WAVE Project focuses on 52 Groundwater Sustainability Agencies (GSAs) that lie across the five core San Joaquin Valley counties of Madera, Fresno, Tulare, Kings, and Kern. These 52 GSAs face similar physical problems of water distribution, critical groundwater overdrafts, and severe recurring drought in the same geographic region but have evolved different Groundwater Sustainability Plans (GSPs)and organizational structures. This project will determine if statewide water policies such as SGMA and its GSAs are successfully scalable.

The Capitalized Aesthetic Value of Stormwater Retention Basins on House Prices in Fresno and Clovis, California

By Andres Jauregui, Gazarian Real Estate Center *andresjauregui@mail.fresnostate.edu*
Collaborators: Qin Fan and Jacquelin Curry

The main goal of this research project is to increase our understanding of the potential capitalization effects of stormwater basins on urban residential house prices. The existing literature provides limited information on the impact of basin features and designs on house prices, as this information is scarce and particularly difficult to collect. In close collaboration with the Fresno Metropolitan Flood Control District (FMFCD), we consider the house price impact of various aesthetic and design features for the more than 150 stormwater basins in Fresno and Clovis, California. Our results are relevant for homebuyers, policymakers, and particularly, flood control agencies.

Measuring Grapevine Water Status Using Landsat 8 Satellite Images

By Eve Laroche-Pinel, Department of Viticulture and Enology *larochepinel@mail.fresnostate.edu*
Collaborators: Kushwinder Singh, Vincenzo Cianciola, and Luca Brillante

Precision viticulture is growing to respond to the grower's request for spatial and temporal information to improve water efficiency. Satellite imagery is a powerful tool to assess vineyard characteristics such as vigor or water content. Landsat 8 is an American Earth observation satellite launched in 2013 with eight bands from the visible (VIS) domain to the short-wave infrared (SWIR) domain with 30m resolution and two thermal infrared bands with 100m resolution. To explore the ability to link satellite information with vineyard characteristics, we set up an experiment in 2020 and 2021 in a Merlot vineyard in the Bakersfield area. A total of 24 experimental units were spatially distributed according to the grid created from the pixel of a Landsat 8 image. Water status was assessed every two weeks in both years, from June to August, measuring midday stem water potentials (Ψstem); we also measured leaf stomatal conductance (gs) and net carbon assimilation rate (AN). Landsat 8 images of the same periods were downloaded, and reflectance values of each experimental unit were extracted and averaged. Machine learning models were applied to predict water status using band reflectance values. Machine learning models (ExtraTree regression with all the Landsat 8 bands as predictors) assess water status with R2 superior to 0.8 for Ψstem, gs, or AN. A feature importance extraction identified the near-infrared (NIR) and SWIR domains as the best bands to predict vine water status in this study. These spectral domains have already been demonstrated to be linked with plant water status. These results confirm the interest in using satellite imagery to monitor vineyards at a large scale and with a good temporal resolution.

Impact of Hydrochar Amendment on the Water Retention Capability of Agricultural Soil

By Jiangjun Li, Student Reasearcher *jiangjunli@mail.fresnostate.edu*
Collaborators: Tianyu Han and Lubo Liu

The water retention capability of soil significantly impacts plant growth. A scarcity of water in agricultural soil may cause low crop productivity, potentially leading to critical food- deficit problems in arid areas with increasing populations such as central California. New ways to enhance the water retention capability of soil to enable farmers to utilize water more effectively are thus urgently needed. Research has shown that hydrochar, which is produced by hydrothermal carbonization (HTC), can potentially improve soil quality by enabling it to hold water for longer periods. This study therefore explored how the addition of hydrochar affects water retention capacity in the root zone using soil experiments. For the experiments, a column filled with sample sandy soil but without hydrochar, which was used

as a control. Meanwhile, 8% weight of hydrochar were mixed with soil at the top of soil columns to investigate how the presence or absence of hydrochar affected: (1) the temporal variation of soil moisture vs depth; (2) the temporal variation in the water's potential head vs. depth at different times; and (3) the distribution of soil moisture vs the water's potential head. The results of these experiments can be utilized to show the agricultural benefit gained by soil amendment with a certain amount of hydrochar.

Water is Life: The Centrality of Water in Science and Nature Documentaries

By Robert Lull, Department of Communications *lull@mail.fresnostate.edu*

Curious about shifts in how science and nature documentaries have told their stories over the last three decades, I have been working for two years building a comprehensive database of closed captioning files to examine that curiosity. The result is a database of 607 film and television scripts that can be analyzed using linguistics tools, including nearly every television program to be nominated for Best Science or Nature Documentary at the Emmy Awards since 2002 (e.g., Your Inner Fish); nearly every program to be nominated for Best Limited Series (e.g., H20: The Molecule that Made Us) or Best Film (e.g., My Octopus Teacher) at the Jackson Hole Wildlife Festival since 1993; nearly every film to be nominated for Best Documentary at the Environmental Media Association Awards since 2003 (e.g., Chasing Coral); and every television program released as part of the BBC Natural History "Planet" series since 2001 (e.g., Blue Planet). In total, this database includes over 3 million words.

Although the primary objective for this research project is to examine linguistic trends unrelated to water, a database of such scope allows for limitless exploration of mere curiosities, such as what themes emerge across a database. Word clouds are a simple but insightful approach to answering that question; they capture the frequency with which words appear across texts and represent that frequency with easy-to-understand visuals.

The word cloud for this database contains a clear message: water is life. The word "water" appears 6,114 times in 534 programs, surpassed only by the word "time" but exceeding such common words as "see," life," and "people." This brief presentation will describe this research, show these results within their word cloud, and conclude with some personal thoughts on how it is no coincidence some of the best programs are, of course, all about water.

Drawing Our Water: Water Awareness Visual Journals

By Amanda Madaville, Department of English *amandaville@csufresno.edu*
Collaborators: Students

Individual and community awareness of the significance of water in our lives is a critical part of water planning and project funding and implementation.

Students create visual/comics water journals to document how their lives touch water -- and where and how -- every day. We use these journals as a first step in thinking about water in our communities and the roles of non-scientists in water planning/issues.

Preserving the Natural Hydrologic Cycle: Everyone Has a Role and Responsibility

By Susan Mirlohi, Department of Public Health *susanmirlohi@csufresno.edu*

The earth's natural water cycle, also known as the hydrologic cycle, describes the continuous movement of water in various and changing states, between the earth's atmosphere, and on and below the earth's surface. While the natural hydrologic cycle does not typically include humans, our survival and existence depend on it. Globally, the earth's water

supply amounts to approximately 333 million cubic miles of water, over 96 percent of which is in oceans and other saline waters. Less than 3% of the world's water supply is freshwater, and most of it is locked up in ice caps and glaciers, leaving less than 1% of the global freshwater supply available for human consumption. About 0.76% of the available freshwater is in groundwater aquifers. Rivers and lakes, the source of most of the water people use, only amount to 0.007% of total available freshwater. With the ongoing and emerging concerns of global water scarcity, preserving the integrity and replenishment of our limited water supply is of critical importance. This presentation will aim to inform, engage, and inspire the audience in recognizing the positive roles that humans can play in preserving the natural hydrologic cycle, and how individuals can contribute to the protection and preservation of the earth's limited water supplies through their own actions.

Remote Sensing of Grapevine Water Status Using Hyperspectral Camera Mounted on an Unmanned Aircraft Vehicle (UAV): Study Case in a Variably Irrigated Vineyard

By Kaylah Vasquez, Department of Viticulture and Enology *krvasquez@mail.fresnostate.edu*
Collaborators: Eve Laroche-Pinel, Luca Brillante, and Guadalupe Partida

Water insecurity has continued to impose production and environmental limitations on both a regional and global scale. As a result, remote sensing has become a valued solution aiming to more adequately budget water supply by identifying spectral and spatial information. The variability of this information can be classified and used as a management resource. We have begun a study in a cabernet sauvignon vineyard in the San Joaquin Valley, where we have installed an automated irrigation system. We created twelve watering zones with four randomized replicates, each irrigated at a different duration from 100 to 40% according to the grower allocation. Spectral information across these zones is collected throughout the growing season using a NIR-SWIR hyperspectral camera (900 to 1700nm) based on an unmanned aircraft vehicle. As water has a high absorption rate in these domains, we attempt to use this information to detect areas of extreme water densities, thus assessing plant water status. The remotely sensed data is ground truthed with plant tissue measurements taken every two weeks from June to harvest, including midday stem water potentials, stomatal conductance, net carbon assimilation rate, and intrinsic water use efficiency. This project will help develop new methods to precisely monitor and manage irrigation in vineyards while providing useful information about plant physiology response to deficit irrigation.

Agriculture Water Efficiency and Pumping Assistance Program for Small Farmers in the San Joaquin Valley

By Kaomine Vang, Center for Irrigation Technology *kaominev@csufresno.edu*

The purpose of the project is to develop a Water Efficiency Technical Assistance program to provide two key services. The first of these services will be to educate growers and their staff on the newest and best management practices in relation to water and irrigation. This training will be conducted in-person and hands-on when possible or through virtual webinars with live demonstrations. The team will emphasize reaching out to socially-disadvantaged farmers and hard-to-reach audiences such as the Spanish-speaking and Hmong communities. Due to the prolong drought issues, the small farms in the San Joaquin Valley are suffering. The Second goal of this program is to expand the Advanced Pumping Efficiency Program (APEP). As most small farms do not have pumps large enough to qualify for the services of the APEP program, this program will give small growers opportunities to get pump testing services. The pump testing and technical assistance will support farmers in identifying inefficient pumps, scheduling pump testing, and provide feedback for pump efficiency improvements.

Drinking Water Outreach

By Elijah Banda, California Water Institute R&E *ebanda@mail.fresnostate.edu*

The California Partnership for the San Joaquin Valley – Water Workgroup facilitated by the Research and Education division of the California Water Institute developed an outreach plan and list of resources that are available to private well owners or part of a small community who have lost or are concerned about losing access to drinking water due to groundwater level. The plan and marketing assets were developed in nine languages to ensure a broad reach. Resources available include, Bottled Water, Water Tanks, Water Assessment Testing, and/or Water Quality Testing.

Has your well gone dry? Worried about your well going dry? Know someone who does? Visit mywellwentdry.com to learn about resources available in your community.

FRESNO STATE

California Water Institute

2703 E Barstow Ave, MS JC133 • Fresno, Ca 93740
559.278.7001 • www.californiawater.org