Habitat Project Suitability Factors

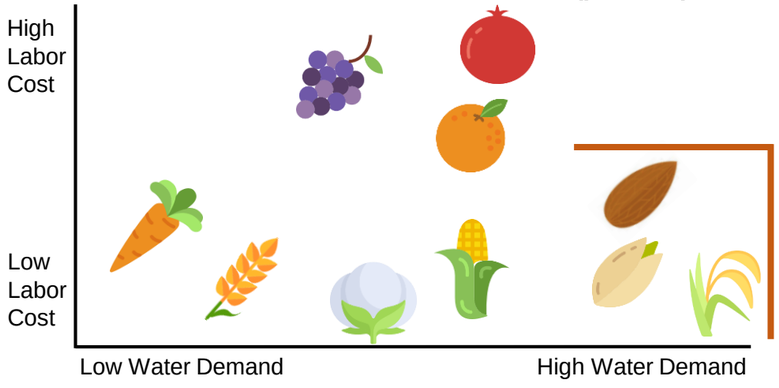
To appropriately consider all factors for successful multi-benefit management projects, our group designed the Multi-Benefit Optimization Model (MBOM) to analyze existing data on agricultural crop revenues, hydrogeologic factors, endangered species habitat, habitat corridors and conservation areas. Major suitability factors included in the MBOM are:

- The Nature Conservancy High Prioritization Areas
- Soil Agricultural Groundwater Banking Index
- San Joaquin Valley kit fox habitat
- Tipton kangaroo rat habitat
- Giant garter snake habitat
- Audubon Important Bird Areas
- California conservation easements
- Habitat corridor and connectivity areas
- USDA agricultural revenue by crop
- Applied irrigation water demand
- Groundwater nitrate concentration
- Depth to shallow groundwater

4 REPLENISHMENT WITH COMMUNITY BENEFITS

It is estimated that 500,000 acres of agriculture will be removed from production in the San Joaquin Valley as a means of complying with SGMA.[1] Rural and disadvantaged communities will particularly face an economic burden in lost agricultural wages. Multi-benefit replenishment projects offer an opportunity to transfer skills from agricultural field work to jobs in habitat restoration. Wetland habitat restoration has been cited as creating 6.8 jobs per $1 million invested, while grasslands (similar to upland) can create 13 jobs given a $1 million investment.[2]

Water Demand vs. Labor Costs (per acre)



Habitat projects can further help improve regional air quality. Kern County consistently ranks as having one of the worst air qualities in the US.

Groundwater savings can be maximized and labor losses minimized by focusing on **alfalfa**, **almonds** and **pistachios**. These crops have high water demand and have a lower labor intensity per acre.

FUTURE OF BASIN BENEFITS

Our group recommended a pilot groundwater replenishment project that will restore upland habitat for a landowner in Kern County, California. The project is expected to break ground in the Fall of 2018. The Environmental Defense Fund will expand the application of MBOM as they continue to partner with additional landowners throughout the San Joaquin Valley.

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ACKOWLEDGEMENTS

We would like to express our thanks to our project partners, the Environmental Defense Fund (EDF); our funders, the Professional Environmental Management Association (PEMA); and the UC Santa Barbara Bren School.

REFERENCES

1. Public Policy Institute. (2016). Water Stress in a Changing San Joaquin Valley.
2. BenDor, T et al. (2013) Exploring and Understanding the Restoration Economy.

More information can be found on our website: http://basinbenefits.weebly.com

BASIN BENEFITS

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Analyzing alternative groundwater management strategies in California's San Joaquin Valley

Wendy Bagnasco, Kelly Bourque, Cristóbal Loyola Angosto, Lindsay McPhail, Anna Schiller
Faculty Adviser: Ashley Larsen
PhD Adviser: Andrew Ayres

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MULTI-BENEFIT GROUNDWATER REPLENISHMENT: POTENTIAL IN THE SAN JOAQUIN VALLEY

California's **San Joaquin Valley** spans 4.2 million acres, produces a total agricultural revenue of $31 billion, and employs 218,500 people.[1] The San Joaquin Valley also relies on groundwater for up to 60% of its agricultural irrigation, soon to be regulated by California's Sustainable Groundwater Management Act (SGMA).[1]

SGMA will require landowners to bring groundwater basins into long-term balance, requiring a significant curtailment of current groundwater use. To meet this goal, it is estimated that farmers will have to retire a substantial amount of agricultural land from production. Groundwater replenishment projects are a viable strategy for landowners to help offset the costs of complying with SGMA.

Objective

Our group examined the viability of implementing groundwater replenishment projects across the San Joaquin Valley. We examined the potential for alternative replenishment strategies that reduce reliance on groundwater, offer financial incentives to landowners, and generate auxiliary co-benefits for the environment.

Key Findings

1. **Multi-benefit groundwater replenishment projects can compensate landowners for creating upland and wetland endangered species habitat.**
2. **Groundwater replenishment projects offset the costs of complying with SGMA. The economic viability of a project type, however, depends on crop profit margin and crop irrigation demand.**
3. **Multi-benefit replenishment projects can be strategically located to minimize cost, maximize groundwater savings, and achieve optimal habitat benefits.**
4. **Although the fallowing of agricultural lands will curtail groundwater use, groundwater reduction targets will lead to a significant labor loss in already disadvantaged communities.**

1 MULTI-BENEFIT REPLENISHMENT ACTIONS

Multi-benefit groundwater replenishment projects allow landowners to comply with SGMA while also providing additional compensation for creating upland and wetland endangered species habitat.

Replenishment with Upland Habitat

- Removing cropland from production to reduce irrigation from groundwater
- Restoring fallowed fields to native, terrestrial habitat

Replenishment with Wetland Habitat

- Removing cropland from production to install a groundwater recharge pond
- Using the recharge pond to function as wetland habitat

Habitat Credits – These upland and wetland replenishment projects are eligible for federal and state conservation payment programs. These programs offer financial incentives for landowners to create endangered species habitat and wetlands in California through either permanent or temporary projects, which can pay up to $100,000 per acre of restoration.

2 REPLENISHMENT BENEFITS EXCEED THE COSTS

Based on our economic cost-benefit analysis, benefits exceed costs for both traditional groundwater replenishment projects and multi-benefit replenishment projects. However, the preferred project strategy for complying with SGMA depends on a crop's profit margin and a crop's irrigation water demand.

Management Strategies:

To comply with SGMA, landowners in the San Joaquin Valley will need to diversify their portfolio of groundwater management strategies. We compared the economic viability of traditional and multi-benefit groundwater replenishment projects across a project period of 2018 – 2045.

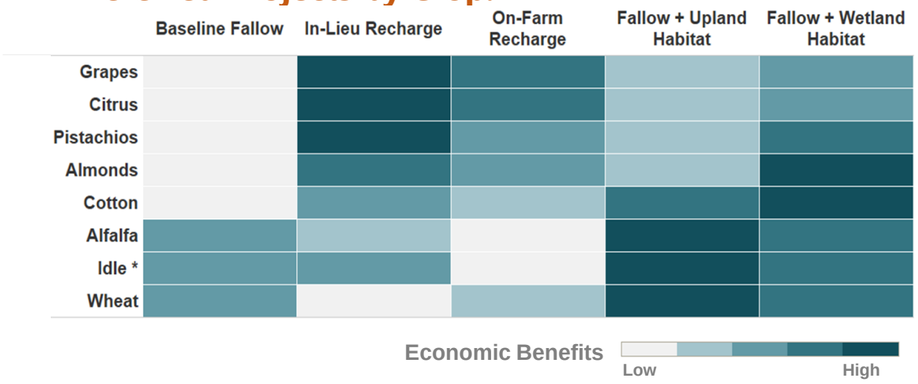
Baseline Fallow – no replenishment project
In-Lieu Recharge – purchasing surface water
On-Farm Recharge – using excess flood flows

Costs & Benefits

Common Costs:
- Forgone crop revenues
- Project construction
- Admin. and legal fees
- Purchased water for irrigation or recharge

Potential Benefits:
- Avoided electricity and operational costs
- Habitat conservation payments from state and federal agencies

Preferred Projects by Crop:



We found that landowners with **high profit margin crops**, such as grapes, should pursue strategies that **allow for full production**. Landowners with **low profit margin crops or crops with high water demand**, such as alfalfa and almonds respectively, **benefit most from multi-benefit strategies.**

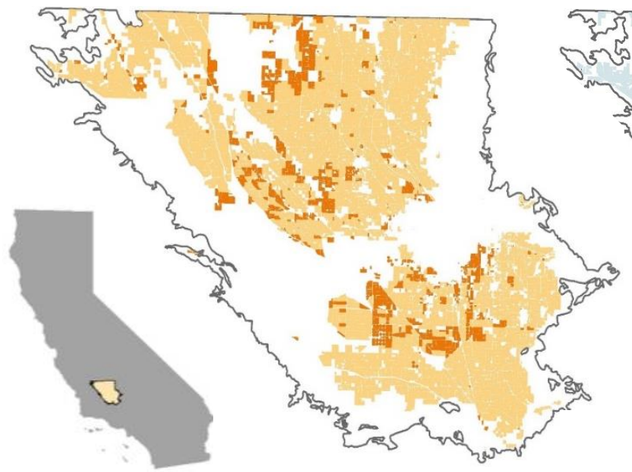
3 STRATEGICALLY LOCATING REPLENISHMENT PROJECTS

Our group developed the **Multi-Benefit Optimization Model (MBOM)**, which combines spatial data on crop revenues, hydrogeologic factors, and endangered species habitat. Based on user-variable inputs, the MBOM determines where to strategically place multi-benefit groundwater replenishment projects in California's San Joaquin Valley. The table below displays MBOM results for Kern County – the most productive agricultural county in the US. **Kern County's annual $7.3 billion agricultural economy is at risk** as farmers reliant on over-drafted groundwater basins will be required to curtail pumping by an estimated 15% by 2040.[1]

Study Area: Kern County	Fallowing (Baseline)	Upland Replenishment	Recharge Pond (Baseline)	Wetland Replenishment
Total Project Acres (acres)	117,368	120,950	5,696	3,665
Replenishment (AFY)	426,670	426,670	663,318	426,580
Habitat Generation (acres)	0	120,950	0	3,663
Total Cost ($ millions)	$265.6	$269.6	$291.7	$288.8

Compared to traditional groundwater replenishment strategies that only maximize groundwater savings (Fallowing and Recharge Ponds), **multi-benefit replenishment projects (Upland and Wetland) can be implemented on retired agricultural lands and achieve the same groundwater savings at a comparable cost, but with added habitat benefits.** We found that across Kern County, achieving groundwater recharge solely through wetland habitat replenishment projects requires a fraction of the land area, but has less potential to create species habitat as compared to upland replenishment strategies.

Kern County Agricultural fields for fallowing projects suitable for upland habitat restoration



Kern County Agricultural fields for fallowing projects suitable for wetland habitat restoration