

## Content of the auxiliary files of

# Water, environment, and socioeconomic justice in California: a multi-benefit framework

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**Abstract:** Low-income, rural frontline communities of California's Central Valley experience environmental and socioeconomic injustice, water insecurity, extremely poor air quality, and lack of fundamental infrastructure (sewage, green areas, health services), which makes them less resilient. Many communities depend financially on agriculture, while water scarcity and associated policy may trigger farmland retirement, further hindering socioeconomic opportunities. Here we propose a multi-benefit framework to repurpose cropland in buffers inside and around (400-m and 1600-m buffers) 154 rural disadvantaged communities of the Central Valley to promote socioeconomic opportunities, environmental benefits, and business diversification. We estimated the potential for (1) reductions in water and pesticide use, nitrogen leaching, and nitrogen gas emissions, (2) managed aquifer recharge, and (3) economic and employment impacts associated with clean industries and solar energy. Retiring cropland within 1600-m buffers resulted in estimated reductions in annual water use of 2.18 km<sup>3</sup>/year, nitrate leaching into local aquifers of 105,500 t/year, greenhouse gas emissions of 2,232,000 t CO<sub>2</sub>-equivalent/year, and 5,388 t pesticides/year, with accompanying losses in agricultural revenue of US\$4,213 million/year and employment of 25,682 positions. Buffer repurposing investments of US\$27 million/year per community for ten years showed potential to generate US\$101 million/year per community (total US\$15,578 million/year) for 30 years and 407 new jobs/year (total 62,697 jobs/year) paying 67% more than prior farmworker jobs. In the San Joaquin Valley (southern Central Valley), where groundwater overdraft averages 2.3 km<sup>3</sup>/year, potential water use reduction is 1.8 km<sup>3</sup>/year. We identified 99 communities with surficial soils adequate for aquifer recharge and canals/rivers within 1600 m. This demonstrates the potential of managed aquifer recharge in buffered zones to substantially reduce overdraft. The buffers framework shows that well-planned land repurposing near disadvantaged communities can create multiple benefits for agriculture and industry stakeholders, while improving quality of life in disadvantaged communities and producing positive externalities for society.

**Key words:** frontline disadvantaged communities; climate justice; energy independence; environmental justice; environmental buffers; groundwater overdraft; sustainability.

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## Contents of this repository:

### 00. Shapes

**00.1. DAC 15 km<sup>2</sup>, buffers, land use clipped:** Folder containing the shapes of California disadvantaged communities by place in the Central Valley (divided in Sacramento Valley and San Joaquin Valley) according to the California Department of Water Resources (2016); land use according to the LandIQ 2016 survey inside disadvantaged communities, 400 m (1/4 mile) around them, and 1600 m (1 mile) around them; oil wells from the WellSTAR database within 1600 m (1 mile) of the selected disadvantaged communities.

The selection of disadvantaged communities includes the 154 smallest (< 15 km<sup>2</sup>) disadvantaged communities of the Central Valley that can benefit from repurposing land inside and/or around them, and that contain cropland inside or 1600 m around them, or that contain oil wells.

**DACs:** disadvantaged communities of the Central Valley of California.

**DACs\_1600m:** 1600-m buffer around each disadvantaged community of the Central Valley.

**DACs\_Sac:** disadvantaged communities of the Sacramento Valley.

**DACs\_SJV:** disadvantaged communities of the San Joaquin Valley.

**Landuse\_Buffer\_SAC\_1600m:** land use in the 1600-m buffer around disadvantaged communities of the Sacramento Valley (LandIQ survey 2016).

**Landuse\_Buffer\_SJV\_1600m:** land use in the 1600-m buffer around disadvantaged communities of the San Joaquin Valley (LandIQ survey 2016).

**Landuse\_Buffer\_SAC\_400m:** land use in the 400-m buffer around disadvantaged communities of the Sacramento Valley (LandIQ survey 2016).

**Landuse\_Buffer\_SJV\_400m:** land use in the 400-m buffer around disadvantaged communities of the San Joaquin Valley (LandIQ survey 2016).

**Land-Use-inside-DACs:** land use inside disadvantaged communities of the Central Valley (LandIQ survey 2016).

**Oil\_wells\_within\_1600m:** oil wells within 1600 m of each disadvantaged community of the Central Valley.

**Sac\_1600-m:** combined shape with all the 1600-m buffers around each disadvantaged communities of the Sacramento Valley (prevents computing land twice when a plot is overlapped by several buffer shapes).

**SJV\_1600-m:** combined shape with all the 1600-m buffers around each disadvantaged communities of the San Joaquin Valley (prevents computing land twice when a plot is overlapped by several buffer shapes).

**00.2. Public data:** folder with shapes publicly available.

**CA\_counties\_shape:** California counties

**Canals\_and\_Aqueducts\_local:** main canals and aqueducts of California

**DComm\_Place\_2016:** disadvantaged communities of California by census place in 2016 from California Department of Water Resources.

**Central Valley Shape pp1766\_cvhm\_texture\_regions:** Central Valley of California.

**Major Rivers and Creeks:** Main rivers and creeks of California.

**Water\_Plan\_Planning\_Areas:** California water planning areas.

**WellSTAR\_Oil\_and\_Gas\_Wells:** oil wells in California.

## **01. Selected disadvantaged communities.xlsx**

List with all disadvantaged communities of California by census place in 2016 with less than 15 km<sup>2</sup> of surface area, detailing median household income, population, and other socioeconomic and geographic indicators.

## **02. Agricultural Land Use Retirement (spatial analysis).xlsx**

Results of the spatial analysis identifying surface area of each crop type, according to the LandIQ survey 2016, inside and around (400 m and 1600 m) small disadvantaged communities of the Central Valley.

## **03. Natural resources use (spatial analysis).xlsx**

Use of natural resources and environmental impacts inside and around (400 m and 1600 m) disadvantaged communities of the Central Valley, including water (surface water and groundwater) and nitrate loading into aquifers, per crop type (including the LandIQ, NAICS, the fertilizer report by Harter et al in 2017, and the California Department of Water Resources classifications).

### **03.1. Pesticide use Central Valley (per section).xlsx**

Amounts of active chemicals in pesticides used in each of the sections of the Public Lands Survey inside and around disadvantaged communities of the Central Valley.

### **03.2. Aquifer recharge distances.xlsx**

Distance between each selected disadvantaged community of the Central Valley and a source of water (river, creek, canal), and the distance to a soil with moderately good, good, or excellent aquifer recharge characteristics.

#### 04. Agricultural Land Use Retirement, and IMPLAN inputs.xlsx

Transformation of cropland retirement into direct revenue losses given by US Federal data and surface area of crop type. Scenarios to repurpose cropland into clean industry and solar energy generation and storage (investment and operations and maintenance).

**04.1. IMPLAN\_Runs:** folder containing 22 folders corresponding to IMPLAN model runs of cropland retirement and repurposing into clean industry and renewable energy scenarios. Each subfolder contains the spillover effects of the direct revenue loss of cropland retirement, and the effects of different levels of potential investments.

**Runs.xlsx:** summary containing the main results of the IMPLAN runs.

#### 05. Cash flow scenarios.xlsx

Spreadsheet summarizing the different investment scenarios in a 30-year project inside and around disadvantaged communities of the Sacramento Valley and the San Joaquin Valley regions. The scenarios include cropland retirement inside disadvantaged communities and around them (400 m and 1600 m); industry investments range from \$10 million invested in 5 years to \$100 invested in 10 years; solar energy investments range from \$21 million invested in 5 years to \$171 invested in 10 years.

We considered 31 communities in the Sacramento Region and 123 communities in the San Joaquin Valley Region.

The surface area needed for Solar ranges from 0.31 km<sup>2</sup> to 3.36 km<sup>2</sup>. The surface area needed for industry depends on the industry but is it only a small fraction of the buffers, leaving enough surface area to implement other land uses with environmental positive externalities that are not as easy to monetize as the ones presented in this table.

#### Sources

Frontline communities in the Central Valley listed as “disadvantaged communities” (census places) by the California Department of Water Resources, <https://gis.water.ca.gov/app/dacs>

Land IQ 2016 survey, <https://data.cnra.ca.gov/dataset/statewide-crop-mapping>

Water use per crop type with water use rates from the California Department of Water Resources (<https://data.cnra.ca.gov/dataset/land-water-use-by-2011-2015>)

pesticide usage based on the Pesticide Use Reports from the California Environmental Protection Agency ([ftp://transfer.cdpr.ca.gov/pub/outgoing/pur\\_archives](ftp://transfer.cdpr.ca.gov/pub/outgoing/pur_archives))

Nitrate (fertilizer) loading <https://ucanr.edu/sites/groundwaternitrate/files/268749.pdf>