An analysis prepared as part of

THE Vivid Picture PROJECT

Agricultural Lands Available for Production in 2030

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Findings

We assess the availability of agricultural lands in 2030 according to potential land-use recommendations. We look first at the amount of agricultural land that would be available in the future if land development and current practices continued unabated. This is our Business as Usual scenario. Starting with 2002 agricultural lands of roughly 28 million acres, we subtract (1) lands projected to be developed by urban expansion according to the Business as Usual scenario described in the paper *Estimating spatially explicit population distribution and urban area expansion in California for the year 2030* and (2) lands anticipated to be retired in the Westlands Water District due to high soil salinity. We find that agricultural lands available in 2030 would total nearly 27 million acres.

We then look at the amount of agricultural land that would be available in the future if we assume that smart growth policies limit urban expansion throughout the state and that the conservation of important ecosystems and wildlife habitat takes place throughout the state. We recognize that these conservation services would take place only with appropriate compensation to agricultural landowners. Starting with 2002 agricultural lands of roughly 28 million acres, we subtract (1) lands projected to be developed by urban expansion according to the Vivid Picture scenario described in the paper *Estimating spatially explicit population distribution and urban area expansion in California for the year 2030*, (2) lands anticipated to be retired in the Westlands Water District due to high soil salinity, and (3) water resource management lands. We find that agricultural lands available in 2030 would total 27.5 million acres. We also calculate the amount of agricultural acreage that would fall within integrated wildlife and habitat management zones but do not subtract this acreage from active production.

The following tables summarize our findings.

Table A. Business as Usual scenario

	Acres in Agricultural lands
Urban Expansion	**1,017,900**
~ Prime Farmland	355,070
~ Farmland of Statewide Importance	70,451
~ Unique Farmland	96,118
~ Farmland of Local Importance	3,395
~ Grazing Land	303,208
~ Other	189,657
Westlands Water District Agricultural lands retirement	**151,395**
~Prime Farmland	1,310
~Farmland of Statewide Importance	137,878
~Unique Farmland	6,354
~Farmland of Local Importance	5,016
~Grazing Land	836
~Other	0
Total agricultural lands - 2002	**28,118,655**
Total agricultural lands available in 2030 under Business as Usual scenario	**26,949,360**

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Table B. Vivid Picture scenario

	Acres in Agricultural lands
Urban Expansion	**99,499**
~ Prime Farmland	22,847
~ Farmland of Statewide Importance	5,968
~ Unique Farmland	22,714
~ Farmland of Local Importance	445
~ Grazing Land	36,752
~ Other	10,774
Westlands Water District Agricultural lands retirement	**151,395**
~Prime Farmland	1,310
~Farmland of Statewide Importance	137,878
~Unique Farmland	6,354
~Farmland of Local Importance	5,016
~Grazing Land	836
~Other	0
Water Resource Management Total	**327,846**
~Riparian Buffers	158,480
~Prime Farmland	14,957
~Farmland of Statewide Importance	0
~Unique Farmland	7,789
~Farmland of Local Importance	24,761
~Grazing Land	110,974
~Other	0
Wetlands	**169,366**
~Prime Farmland	18,936
~Farmland of Statewide Importance	4,520
~Unique Farmland	7,898
~Farmland of Local Importance	23,445
~Grazing Land	113,455
~Other	1,111
Integrated wildlife and habitat management acres	
Areas of Critical Environmental Concern	226,725
Critical Habitat	3,991,826
Migration Corridors	2,654,688
Total integrated wildlife and habitat management acres (recommended acres to be integrated into agricultural farming systems for further habitat and wildlife management)	**6,873,239**
Total agricultural lands - 2002	**28,118,655**
Total Agricultural acres available in 2030 under Vivid Picture scenario	**27,539,915**

Introduction

The Vivid Picture project describes a vision of a sustainable food system in the state of California in the year 2030 and proposes a change agenda for reaching that future. In this paper, we look at factors that might affect the total agricultural footprint: the accommodation of projected urban expansion and the conservation of important ecosystems and wildlife habitat.

California's nearly 100 million acre land base is split almost evenly between public and private lands. More than half of the private lands, approximately 28 million acres, are presently dedicated to agricultural production, compared to 5.5 million acres reserved for urban use. Other acreage is primarily State and Federal lands.

Pressures on this agricultural land base will mount as the state's population increases. The California Department of Finance estimates statewide population to grow from an approximately 34 million in the year 2000 to over 48 million in the year 2030.[1] Millions of new Californians will necessitate the development of new houses, roads, schools, offices, and shopping areas—construction that will diminish the acreage of lands available for agricultural production. Other pressures on the state's agricultural lands are ecological in nature, including the need to maintain water quality and to allow for wildlife habitat.

Background

The California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program (FMMP) has created a GIS data layer that defines the current distribution of California's 28,118,655 acres of agricultural lands. This is the most current GIS data available at the time of this publication. Since the 1980's the FMMP has been measuring urban conversions and other land use changes at two-year intervals. The FMMP measures these land use changes on a statewide level using aerial photography and modern soil surveys. Since the FMMP is highly dependent on the NRCS data, the extent of the farmland coverage corresponds to the availability of what the National Resources Conservation Service (NRCS) considers "modern soil surveys", or SSURGO data. Thus, coverage is so far limited to 48 of California's 58 counties. Some of these 48 counties have only been partially mapped as the NRCS has limited its efforts to areas that are agriculturally important. Though the important farmland data does not cover all parts of California, the areas not surveyed either typically contain large public land holdings, such as National Forest, or are reserved to small private lands that are not covered by modern soil surveys[2]. Thus, 91% of all private lands have been mapped at this time using the following mapping categories:

1. Prime Farmland
2. Farmland of Statewide Importance
3. Unique Farmland
4. Farmland of Local Importance
5. Grazing Land
6. Urban and Built Up Land

7. Other Land
8. Water

(More detailed information on how the classifications are assigned can be downloaded in PDF format through the Division of Land Resource Protection website[3].)

Another limitation of this data source is that the FMMP data layer was created with a minimum mapping unit of 10 acres, and all parcels of land that were smaller than 10 acres were incorporated into the surrounding map categories, excluding farms of this size. Small community supported agriculture programs and community gardens were also omitted because they are often located within urban boundaries. Given the data limitations to date, the figures contained in this report should be used as estimates only.

Methods

Data Acquisition

Because there are an inordinate number of databases, statistics, and GIS coverages available at various levels of detail and quality, the Vivid Picture team set a standard for our data acquisition. Our goal was to use existing data whenever possible, following the below criteria, and from them create meaning that was appropriate for this project. Only in cases when data that was necessary for this analysis did not exist, and our methodology could be verified by scientific advisors, did we create new data layers.

In order to ensure accuracy in our results and to meet the goals of the project, we sought data that met the following criteria:

Credible - Data should come from known agencies, or organizations with proven reliability. When possible the data should be certified by academics.

Statewide Coverage - The extent of the data should be comprehensive. This means that the data should cover the entire state of California whenever possible. In certain cases the data was not complete in its coverage, due to uncompleted surveys. However, whenever possible the data was compiled so that it was consistent across regions.

Appropriate Scale - It was important to choose a scale that would yield accurate results in acres without burdening the model with unreasonable processing time. All data used in this project are on a scale not greater than 1:250,000 and no more precise than 1:24,000.

Current - To ensure that the projected results are as up to date as possible more recent data sets were preferred. When new versions of a data set became available they were substituted for the older one.

Publicly accessible - An effort was made to use widely available information so that work in Vivid Picture can be replicated and verified by other groups

Updated - The data set should be managed in an on going so that the Vivid Picture analysis can be calibrated and replicated in the future by us and other groups

Data layers were compiled from different sources and merged in order to show the two dominant themes representing all lands that may be considered high-priority candidates

for conservation and projected urban growth. The first theme was based both on hydrographic factors (which included riparian corridors, floodways using FEMA data, and wetland data from the National Wetland Inventory), as well as areas of critical environmental concern and wildlife corridors. The second theme was based on projected urban growth in the year 2030 and was used to represent human expansion into agricultural areas. These themes were then overlaid onto present agricultural lands of importance. This was done in order to evaluate the individual farmland types that co-exist on the different overlay layers. Hence, specific acreages of overlap can be calculated to show areas where there is potential for future agricultural loss. This analysis was done using a raster environment in order to allow the models parameters to be adjusted and the various results of the analysis could be compared.

Data Transformation

Since many of the data layers that were collected were created on different projections, the first step of the analysis was to put them all on a common projection and extent. All data layers were re-projected to California Teale Projection and clipped only to include information within the California State borders.

Once all of the information was in a common format it was converted to grid and resampled into the raster format. The cell size of the grid was 25 meters. This means that each cell on the map represented 25 square meters in the ground. It is possible to create grids with a smaller cell size, but we chose 25 meters because the Vivid Picture project seeks to provide a large-scale picture of general trends for the entire state. The information found in the maps is not intended to provide detailed information within localized areas.

Model

Once all of the raster coverages were prepared they were overlaid on a single map. The map contained three primary themes: Present Agricultural lands, Urban Growth, and the Environmental Conservation options.

Each cell took on a unique code to denote what layers intersected that cell. For example, a cell that contained Riparian Areas, Critical Habitat, and Prime Farmland was assigned the value of 216—where 6 represents Prime Farmland, the 1 represents riparian areas, and the 2 represents the critical habitat. To determine the total number of acres of agriculture that will be affected in the year 2030, the number of cells with each value were counted and then converted from square meters to acres. Because we are able to isolate how each cell is affected, only agricultural lands left after urban expansion in 2030 were considered for the environmental conservation options.

Results

Business As Usual Scenario

To make Business as Usual projections about agricultural lands in the year 2030, we overlay the FMMP data with appropriate data layers, in order to accommodate two changes: retirement of agricultural land in the Westlands Water District and agricultural lands lost due to projected urban growth.

Retirement of agricultural land in the Westlands Water District
Due to high levels of soil salinity and poor drainage, our research anticipates the retirement of 151,395 acres of farmland near Fresno.[4]

Agricultural acreage lost to projected urban growth
Using Business as Usual projections of urban growth, our analysis—described in the paper Estimating spatially explicit population distribution and urban area expansion in California for the year 2030—concludes that 1,017,900 acres would be removed from agricultural production by the year 2030. The expanding development that will accommodate California's eleven million new citizens will likely come in two forms: the creation of new, undeveloped sites and the expansion (through increased density) of existing developments, commonly referred to as infill.

Vivid Picture scenario

To make Vivid Picture projections about agricultural lands in the year 2030, we overlay the FMMP data with appropriate data layers, in order to accommodate the following changes: retirement of acreage in the Westlands Water District, agricultural lands lost due to projected urban growth, and conservation measures.

Retirement of agricultural land in the Westlands Water District
This acreage is the same as above.

Agricultural acreage lost to projected urban growth
Our analysis—described in the paper *Estimating spatially explicit population distribution and urban area expansion in California for the year* 2030—finds that nearly a million acres of agricultural lands would be preserved through the implementation of a statewide smart growth plan. The number of agricultural acres lost to projected urban growth would be 99,499.

Conservation measures
The Vivid Picture scenario identifies ways to maintain California's natural resources for future generations of farmers and urban dwellers.

1. Riparian buffers
We find that a total of 158,480 acres would be removed from agricultural production through a designation of riparian buffers that offer protection for riverbank ecology. Protecting a thin strip of land along the streams and rivers in agricultural areas can have many benefits, including filtering pollution from organic and inorganic matter from surface and sub-surface flows, protecting banks from erosion, increasing rainfall absorption, reducing flooding, as well as reducing air, water and soil temperatures[5]. Riparian buffers have also been shown to increase regional biodiversity[6]. In some cases, the buffers can serve as migration corridors for birds[7] and larger mammals[8].

To identify the agricultural lands that may be conserved through riparian protection we begin our analysis with two GIS data layers: Hydrarca, a line coverage depicting California's rivers and streams, and Hydrapola highlighting lakes, and some larger river systems. Hydrarca and Hydrapola were assembled by TEALE Data Center from data originally published by the U.S. Geological Survey (USGS) in Digital Line Graph (DLG-3) format and processed. This data was manually digitized from maps at a 1: 100,000 scale

in 1993 and has been frequently updated through 1998. These layers provide the most detailed information of stream, river and lake locations available statewide at this time. Other available hydrology data sets were not selected due to the fact that they included only major rivers, covered limited regions, or were at an inappropriate scale.

To transform the line data into a measurement of acreage, a 50-foot buffer is applied to all streams located in agricultural lands, providing in many cases an effective buffer of less than 50 feet. When no stream-width data is available on the Hydrapola data layer, we apply the 50-foot buffer to the center of the channel on the Hydrarca layer, which in effect reduces the buffer by half the stream width. A stream that is 30 feet wide, or 15 feet from the center of the channel to each bank, for example, will thus have a 35-foot buffer:

50 feet	applied buffer
– 15 feet	from the center of the channel to the bank
35 feet	effective buffer

We find that a total of 158,480 acres would be removed from agricultural production through this riparian conservation. A designated buffer of up to 50 feet is in line with the USDA Food Service Agency's Conservation Reserve Program requirement of 35 feet[9] and with standards set by the Food Alliance, which build from a Level 1 allowance of under 25 feet to a Level 4 requirement of at least 50 feet.[10]

2. Wetlands

We find that, by following the National Wetlands Inventory, 169,366 acres of current agricultural land would be designated as stand-alone wetlands. Lands currently used as farmland and managed as wetlands, such as many well-managed rice fields, are wetlands that are in addition to the 169,366 of wetlands preservation identified by this analysis. Wetlands are unique ecological systems that provide important habitat for plants, animals, birds, reptiles, and fish. Wetlands serve as important sources for water storage and filtration. In some cases wetlands can function as economically viable tools for filtration of non-point source nitrogen pollution[11.]

The geographic data for the wetlands designation come from the National Wetlands Inventory (NWI). The US Fish and Wildlife Service collected information for the nationwide inventory between February 1971 and November 1997. Wetlands are identified from high-altitude imagery based on vegetation, visible hydrology, and geography. The GIS data is collected at various scales depending on the location and some of this data is 20 years older or more. While better data layers exist for specific areas of the state, this is the best coverage that is consistent statewide. Preserving the wetlands identified by the NWI will remove 169,366 acres from agriculture in the year 2030.

A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis. Depending on season and the year of the photo, the imagery could be an overestimate or underestimate.

Another potential shortcoming of the data is that it may ignore "vernal pools": Vernal pools are seasonal wetlands in which surface water appears after major precipitation events or when the water table rise to higher levels. Vernal pools are home to amphibious animals and unique species that rely on the changing nature of the terrain for mating

and maturation[12]. However, due to the high number of endangered and important species that make their homes in vernal pools, it is likely that they will be included in the analysis coverage of critical habitats. Furthermore, there are plans underway in USFW to protect many of these sensitive and important areas in Southern Oregon and California[13].

3. Wildlife Habitat

We find that, to provide for wildlife habitat that meets Vivid Picture goals, 4,218,551 acres of current agricultural land would be designated as integrated habitat management areas. A growing body of research on "farming with the wild" and the emergence of organizations such as the Wild Farm Alliance and Salmon Safe lead us to believe that, with the designation of integrated wildlife management areas, these farmlands can continue to be farmed according to an evolving set of specific principles and standards. However, further data creation and analysis may show that, in order to meet Vivid Picture goals, some of the 4,218,551 acres would best be designated as preservation zones.

The United States Department of Fish and Wildlife (USFW) has identified these key habitat areas and through field research, has digitized the areas deemed the most critical. Critical habitat is defined as specific areas that (1) are essential to the conservation of a federally listed species and (2) may require special management considerations or protection. Critical habitat is determined using the best available scientific information about the physical and biological needs of the species.

These needs, or "primary constituent elements," include: space for individual and population growth and for normal behavior; food, water, light, air, minerals, or other nutritional or physiological needs; cover or shelter; sites for breeding, reproduction and rearing of offspring; habitat that is protected from disturbance or is representative of the historical geographic and ecological distribution of a species.[14]

There is no statewide coverage for federally listed species because each regional office develops the GIS maps for USFW critical habitat. In California there are four USFW regional offices: Arcata, Sacramento, Ventura, and Carlsbad. All the information was collected based on field observations and historical data. Currently, however, there is no standardized process for creating digital data amongst the different regional offices, and thus data was compiled from each region separately, re-projected and then merged before analysis could be undertaken.

California is unique not only for its wildlife but also because of rare ecological areas and locations of historical and cultural importance. The Bureau of Land Management (BLM) keeps record of all areas within its jurisdiction that area considered Areas of Critical Concern (ACEC). The designation of Areas of Critical Environmental Concern (ACECs) is authorized in Section 202 (c)(3) of the Federal Land Policy and Management Act of 1976 (FLPMA, P.L. 94-579). ACECs include public lands where special management attention and direction is needed to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish, or wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. ACEC designation indicates BLM recognizes the significant values of the area and intends to implement management to protect and enhance the resource values.[15]

The ACEC map for the California region was created in 2000 at a 1:24,000 scale. The map only has information on land that is designated as BLM, but when combined with

the USFW data, the two maps should give a thorough coverage of important habitat. The lands reserved for conservation of critical habitat will not be the only areas reserved for open space and wildlife. Other data available tend to focus on specific regions, species, or a single detailed study. These two data sources are the only statewide and regularly updated sources for wildlife habitat.

We find that the Department of Fish and Wildlife designation of critical habitat intersects with 3,991,826 agricultural acres, and the Bureau of Land Management designation of Areas of Critical Environmental Concern intersects with 226,725 agricultural acres, for a total of 4,218,551 acres.

4. Wildlife Corridors

With the fragmentation of natural areas, animal populations are becoming overcrowded. In some fragmented areas there is no longer a critical population mass to ensure species survival. With too few mature animals, low birth rates can lead to extinction[16]. We find that, to provide for wildlife corridors that meet Vivid Picture goals, 2,654,688 acres of current agricultural land would be designated as wildlife corridors. A growing body of research on "farming with the wild" and the emergence of organizations such as the Wild Farm Alliance and Salmon Safe lead us to believe that, with the designation of integrated wildlife management areas, these farmlands can continue to be farmed according to an evolving set of specific principles and standards.

Data for the location and paths of migration corridors comes from the California Wilderness Coalition, following a “Missing Linkages” conference in 2000. The conference was co-sponsored by the Nature Conservancy, the Biological Resource Division of the U.S. Geological Survey, the Center for Reproduction of Endangered Species, and California State Parks. A diverse mix of agency staff, conservationists, and university scientists attended the conference and worked together to delineate California’s most important linkages, along with pertinent annotations for each linkage. No other statewide maps exist that provide information on missing migration corridors.

The spatial data shows general areas where linkages are recommended, rather than specific locations. A more thorough, detailed analysis would be needed in order to determine the exact location and width of these corridors. However, at this time it is the only digital data that exists to highlight wildlife linkages throughout California. Since it is line coverage without area, it was necessary to create an appropriate buffer width before this dataset could be used for our analysis. Based upon the corridor requirements of umbrella species such as mountain lions, which are large wide ranging carnivores[17], we followed a buffer width of 2.5 kilometers. When applied to all of the corridors, this buffer of 2.5 kilometers results in an additional 2,654,688 acres of agriculture lands designated as integrated wildlife management areas.

Endnotes

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[2] Nicolai V. Kuminoff, Alvin D. Sokolow and Daniel A. Sumner, "Farmland Conversion: Perceptions and Realities" *AIC Issue Briefs no. 16, Appendix I*, 2001

1 www.consrv.ca.gov/DLRP/fmmp/index.htm

3 www.consrv.ca.gov/DLRP/fmmp/overview/prime_farmland_fmmp.htm

4 Based on interviews with numerous experts.

[5] www.unl.edu/nac/afnotes/rip-2/rip-2.pdf

[6] Robert J. Naiman; Henri Decamps; Michael Pollock. 1993. The Role of Riparian Corridors in Maintaining Regional Biodiversity. *Ecological Applications*. May 1993. 3(2): 209 – 12.

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