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Biofuels and the AB 118 sustainability standards

California Energy Commission

April 9, 2009

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UC DAVIS
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AB 118 sustainability standards

1. Background on efficient production of energy from agriculture.
2. The assessment of potential biofuel production in CA
3. How to think about sustainability, and standards setting

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What do we mean by agricultural sustainability?

The debate over sustainability means discussing the implications of different choices when looking for compromise solutions between two pressures:

1. Economic pressure driving further intensification (higher rates of throughputs per acre and per hour of labor)
2. Ecological limitations or pressure to reduce the rate of throughput because lower input systems may have less local environmental impact.

M. Giampietro, 2004

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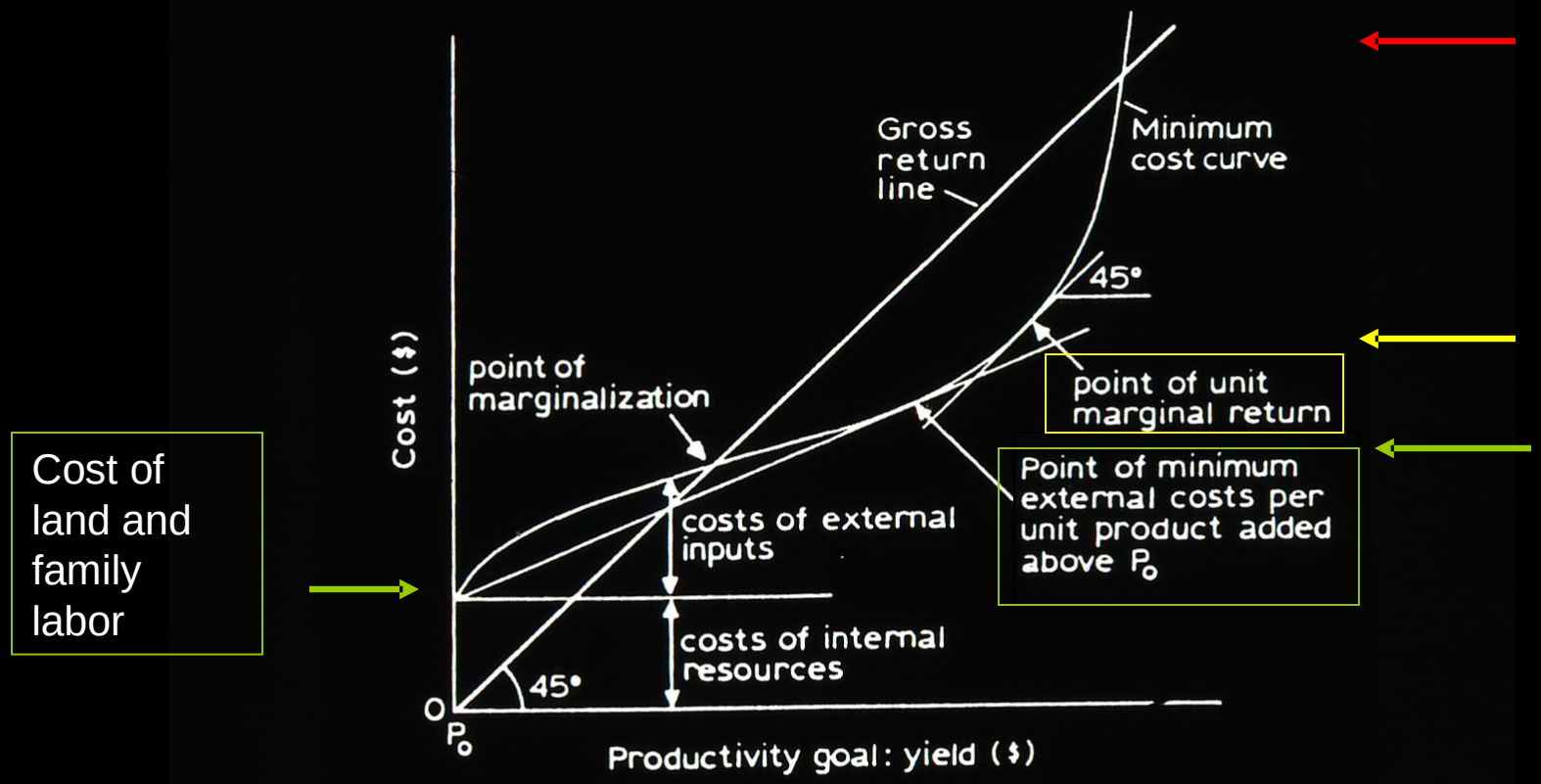

Minimum production costs as a function of productivity (or profitablity) goals of farming systems. (de Wit, 1992 adapted from Holt, 1988).

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De Wit, 1992, Agric. Sys.

"… a feature of (agricultural) intensification is that it is not the improvement of one growing factor that is decisive, but the improvement of a number of them."

This leads to positive interactions that result in the total effect of all these improvements being larger than the sum of the effects adopted separately.

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Increasing returns to total factor productivity :

The need for nutrients and water, expressed per unit surface area, increases with the yield level,

but decreases when expressed per unit yield.

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de Wit 1992

Increasing returns with fewer inputs:

At the highest production levels, it is easier to manage inputs with good efficiency than at lower production levels. (Responses to inputs are better understood and managed).

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De Wit, 1992

The overall environmental impact of food production is minimized via intensification.

But while the need for energy, fertilizers, and biocides per unit product is lowest, local environmental standards may be threatened … and

Cropping systems tend to become specialized, with fewer crops grown in the areas where it is most efficient to produce them.

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Safflower and Residual Nitrogen Management

Elias Bassil, Stephen Kaffka, Bob Hutmacher

J. Agric Sci., Camb. 2002

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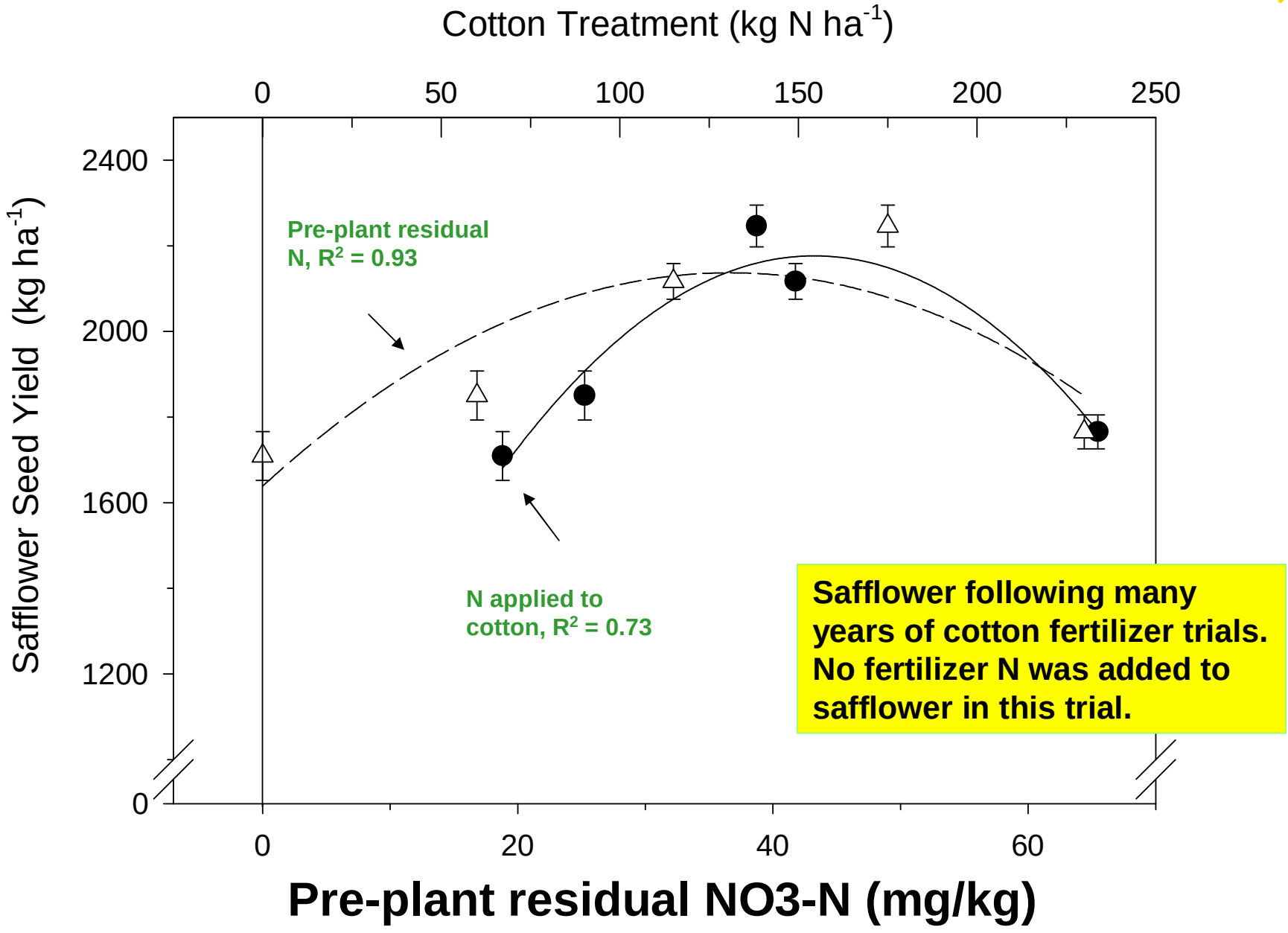
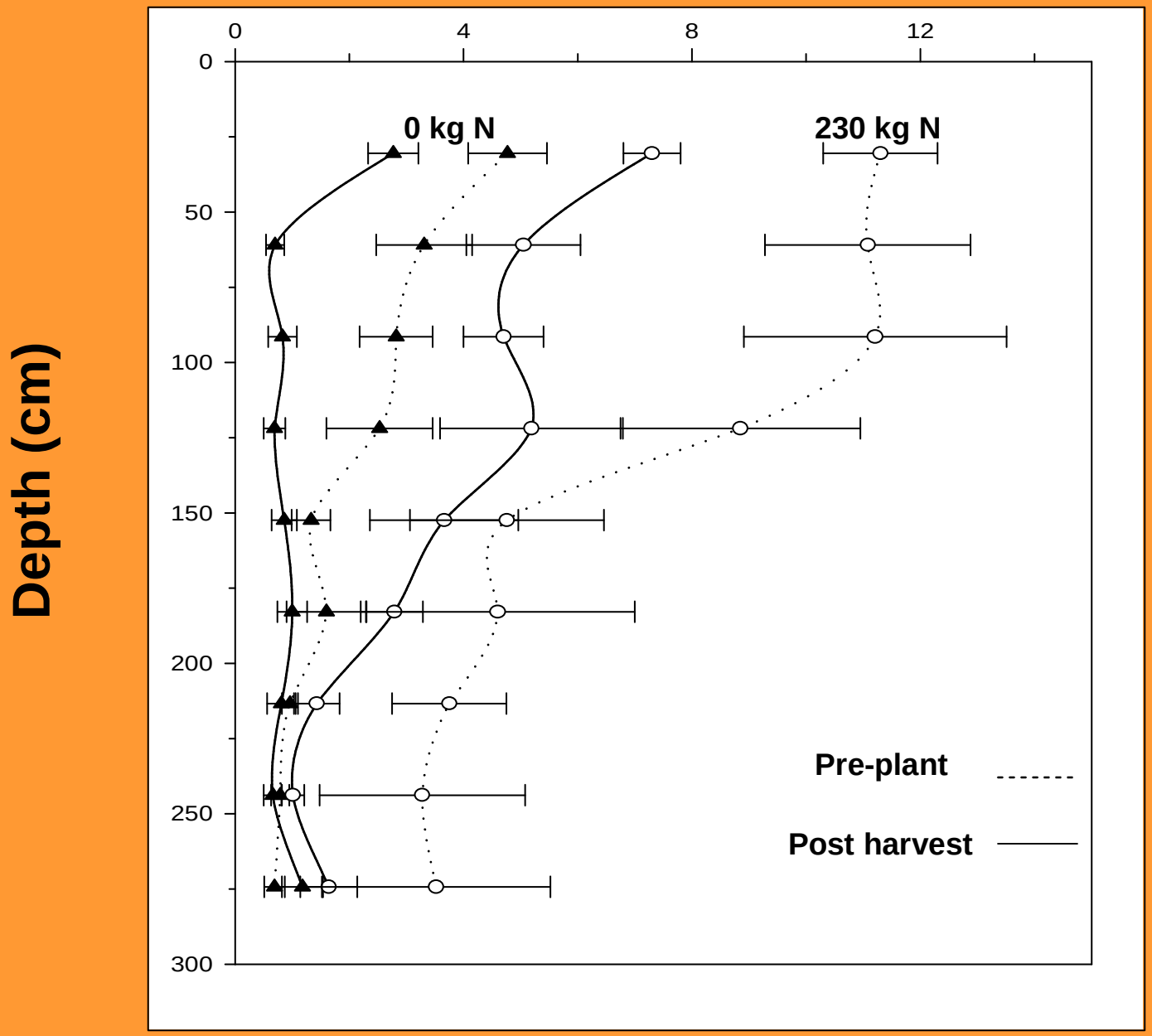

Cotton Treatment (kg N ha-1)
0
50
100
150
200
250
2400
2000
1600
1200
0
Safflower Seed Yield (kg ha-1)
Pre-plant residual N, R2 = 0.93
N applied to cotton, R2 = 0.73
Safflower following many years of cotton fertilizer trials. No fertilizer N was added to safflower in this trial.
0
20
40
60
Pre-plant residual NO3-N (mg/kg)

Change in soil NO3-N during growth (mg/kg)



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1. It is not food (or feed) vs fuels, but a question of how to create more sustainable agro-ecosystems (more diverse, more profitable). In many cases, crops grown for biomass may facilitate that process, not only in CA but also in many locations in the developing world were human need is great.

2. The distinction between first generation biofuels and second generation biofuels is partially arbitrary and misleading … If the entire crop plant were used (corn, sugarbeets), then net energy yields could be similar to or even greater compared to so-called 2nd gen crops like switch grass.

3. An integrated bio-refinery may change the production of energy to a by-product or waste management process rather than the primary activity. This may require a rethinking of categories and carbon accounting methods.

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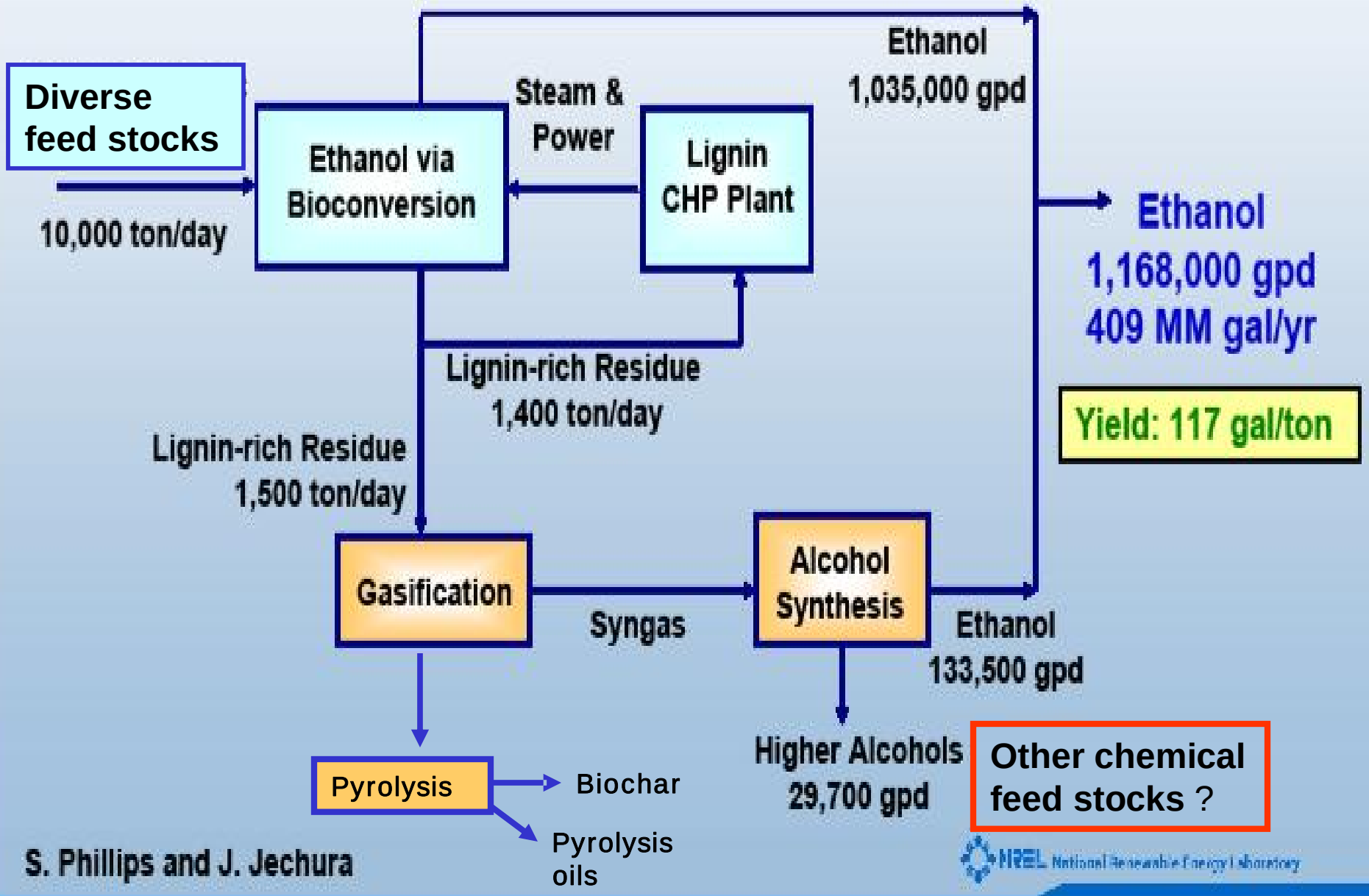
Potential future bio-refinery



S. Phillips and J. Jechura

NREL National Renewable Energy Laboratory

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Sudzucker factory: Zeitz, Germany

Powered by lignite plus biomass

Feedstocks: sugarbeets, small grains, maize

Products: ethanol (350 M L/yr), biogas, electricity, animal feeds, nutrients

Pending: chemical feed stocks

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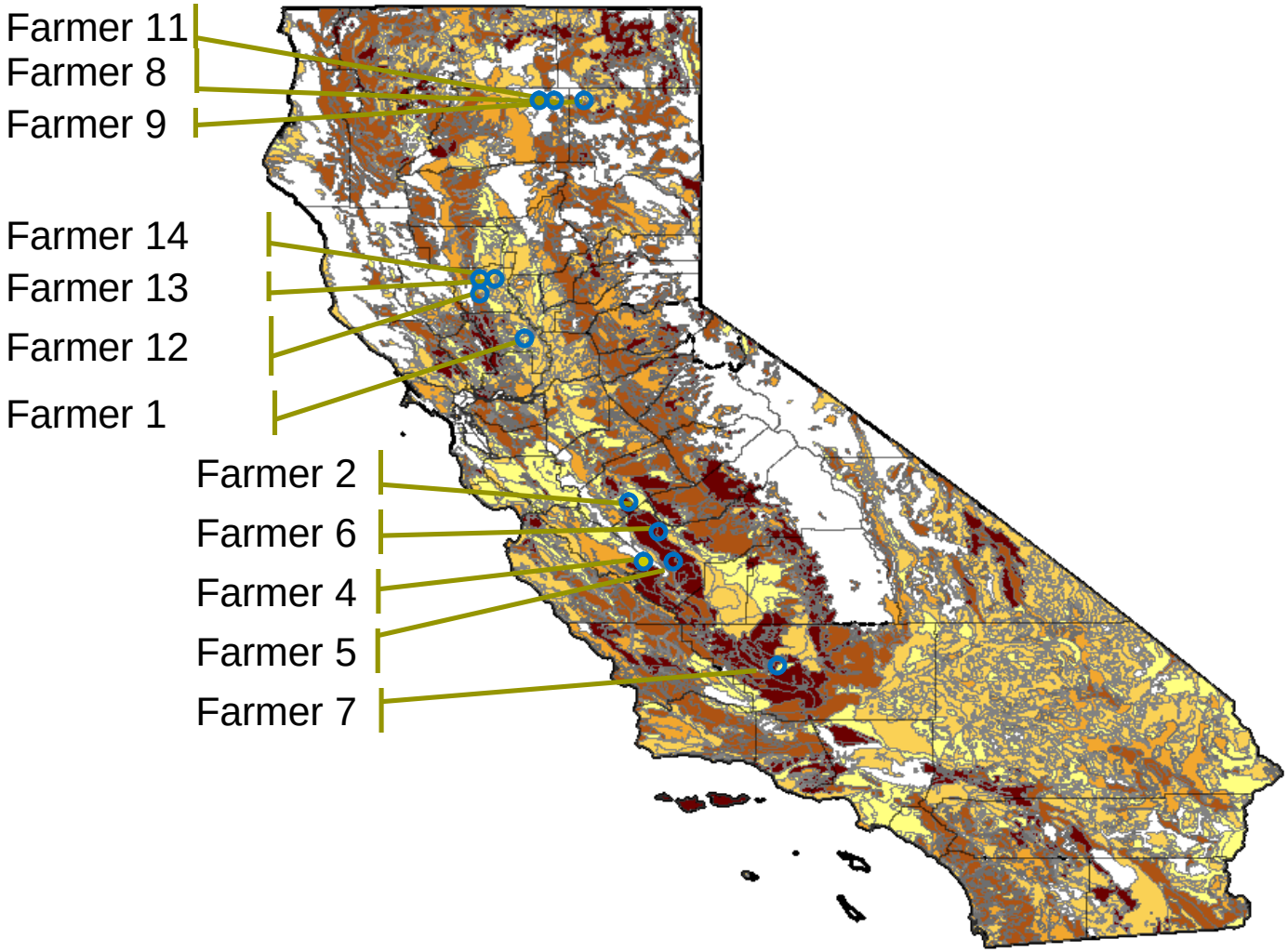
Biofuel Crop Adoption in California

Fujin Yi

Stephen Kaffka

Soil map and farmers' locations



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3.1. Sample Description

Sample farmers' production cost comparison (San Joaquin Valley)

	Merced	Fresno				Kern	UC cost & return study data
	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7	
1.Alfalfa (hay)	1400		1282 (0.34)	1324 (0.57)	754 (0.04)	965 (0.18)	804 (SJV, 2008)
2. Alfalfa (seed)			1677 (0.15)				--
3. Corn (silage)	425				770 (0.04)		972 (SJV, 2008)
4. Corn (grain)			759 (0.41)				1002 (SJV, 2008)
5. Cotton (30-inch row)	1250						736 (SJV, 2003)
6. Cotton (Transgenic)					754 (0.05)		671 (SJV, 2003)
7 Cotton (Pima		1990		1280 (0.35)		740 (0.14)	791 (SJV, 2003)
8. Galic			775 (0.40)				--
9. Melon			747 (0.25)				--
11. Spinach			603 (0.21)				--
12. Sugar beet			517 (0.36)				--
13. Tomato			1581 (0.20)	2139 (0.14)			2017 (SCV, 2008)
14 Tomato (fresh				2434 (0.14)			5458 (SJV, 2007)
15. Wheat			420 (0.45)	737 (0.41)		395 (0.18)	488 (SJV, 2008)
16. Winter forage	250						351 (SJV, 2004)
17. Sudan grass						373 (0.33)	501 (INV, 2004)

Notes:(1) SCV-Sacramento Valley; SJV-San Joaquin Valley; IV-Imperial Valley; IM-Intermountain area;

(2) The number in brackets is the percentage of irrigation cost in the total cost

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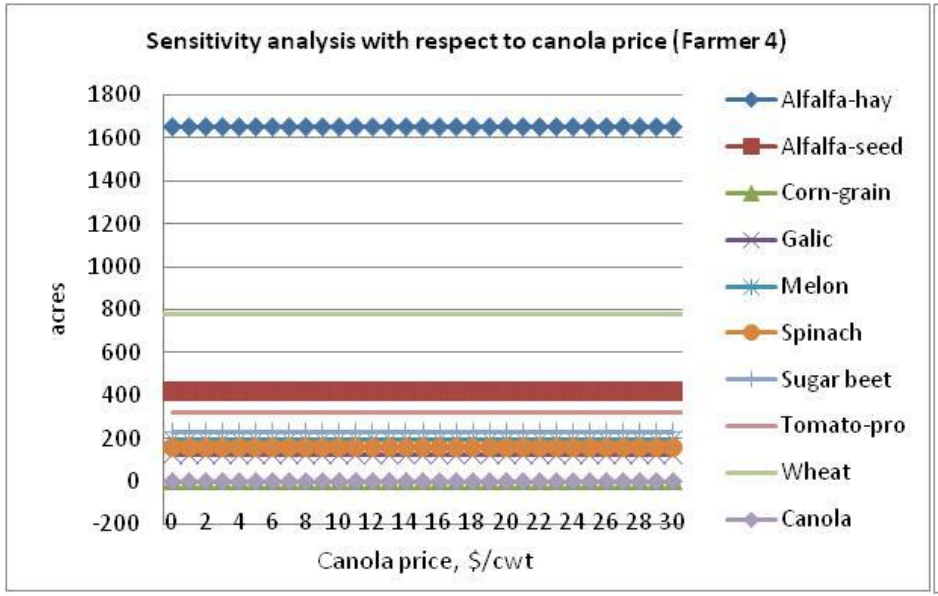
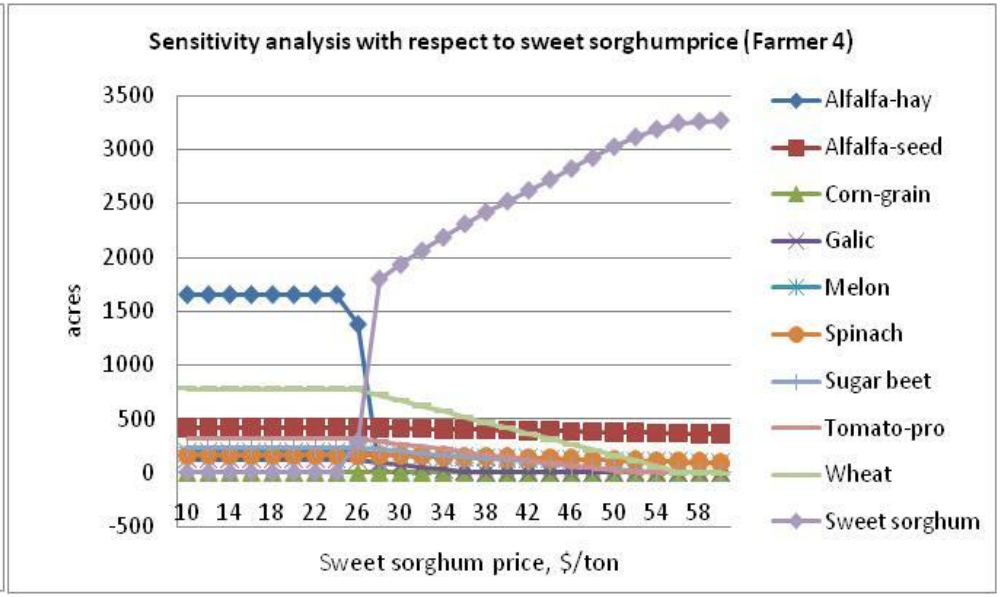
Example1: sensitivity analysis with respect to biofuel crop price change (San Joaquin Valley)





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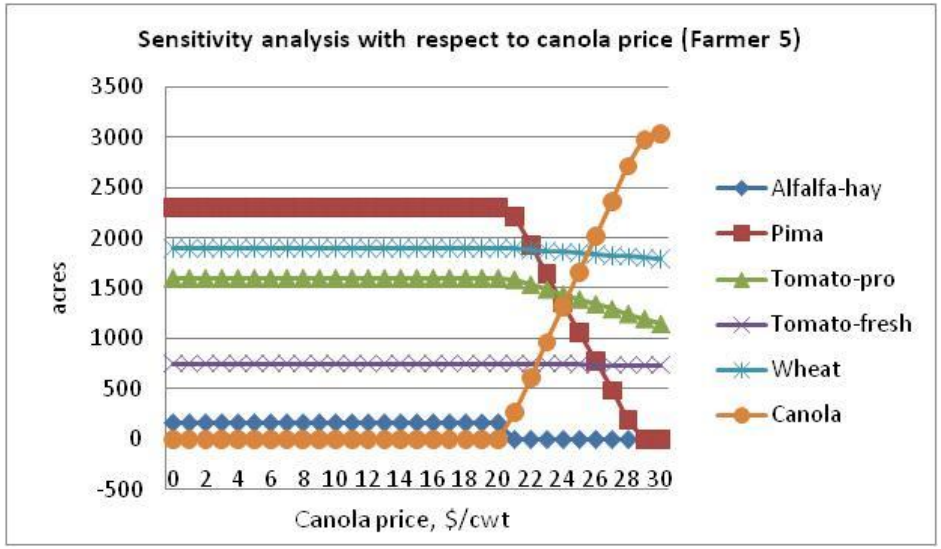

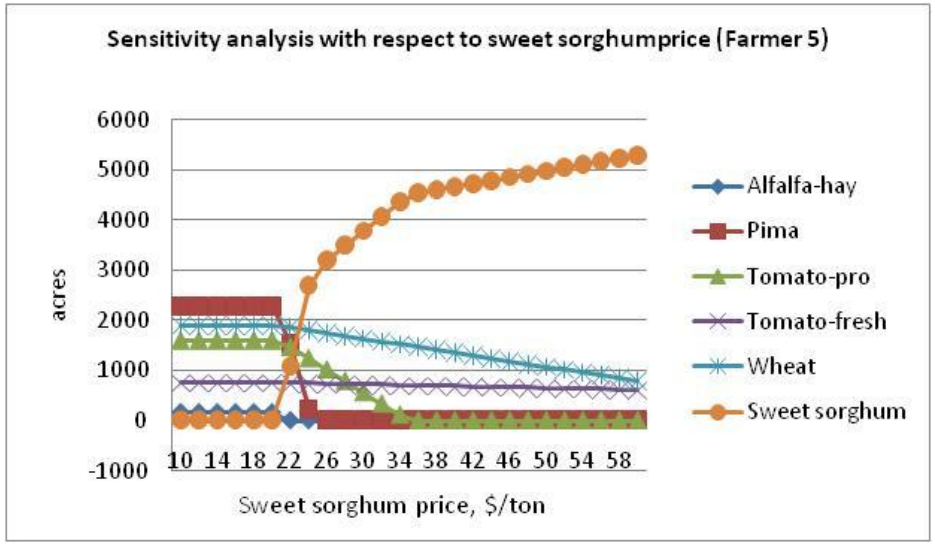

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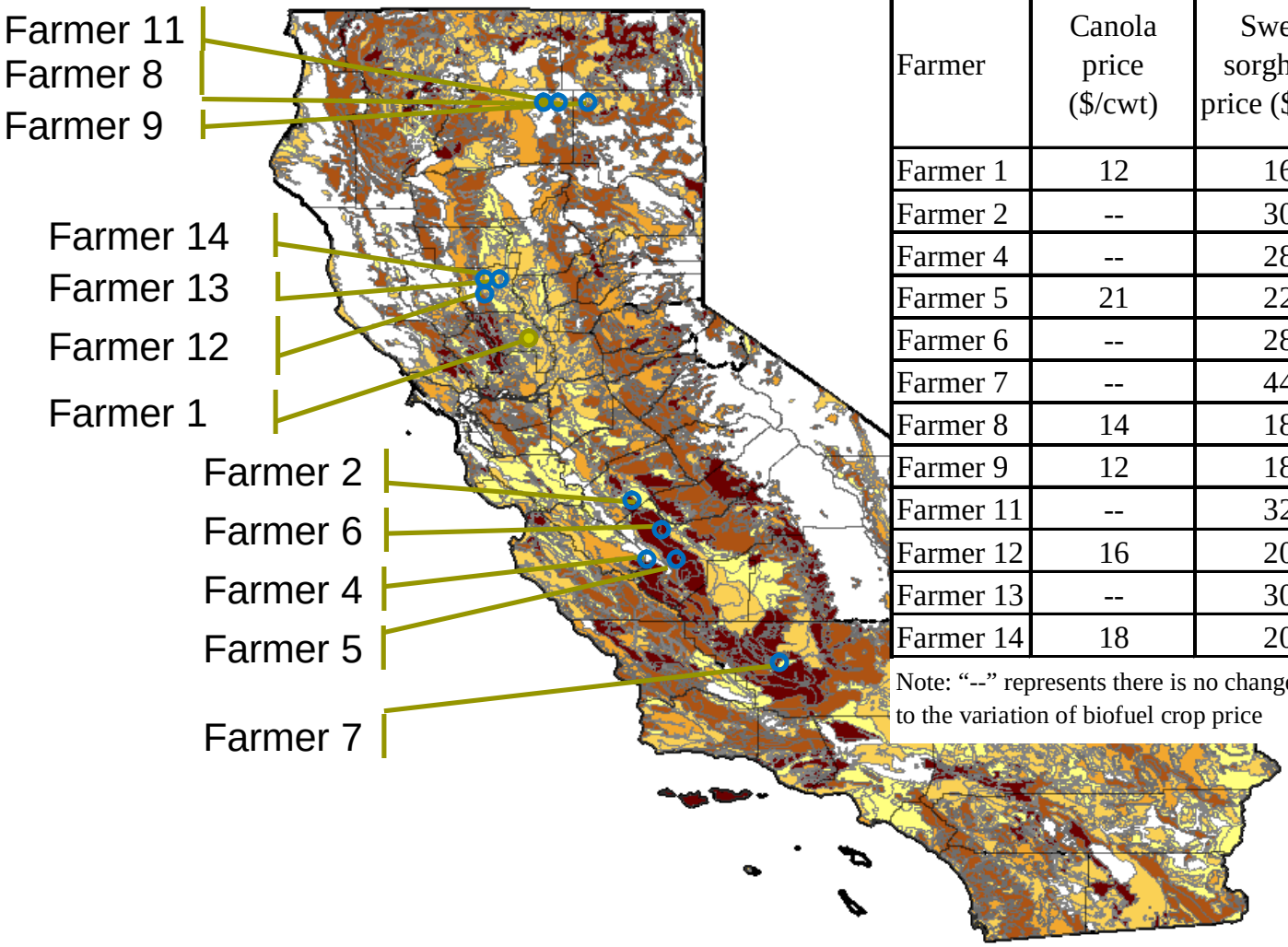
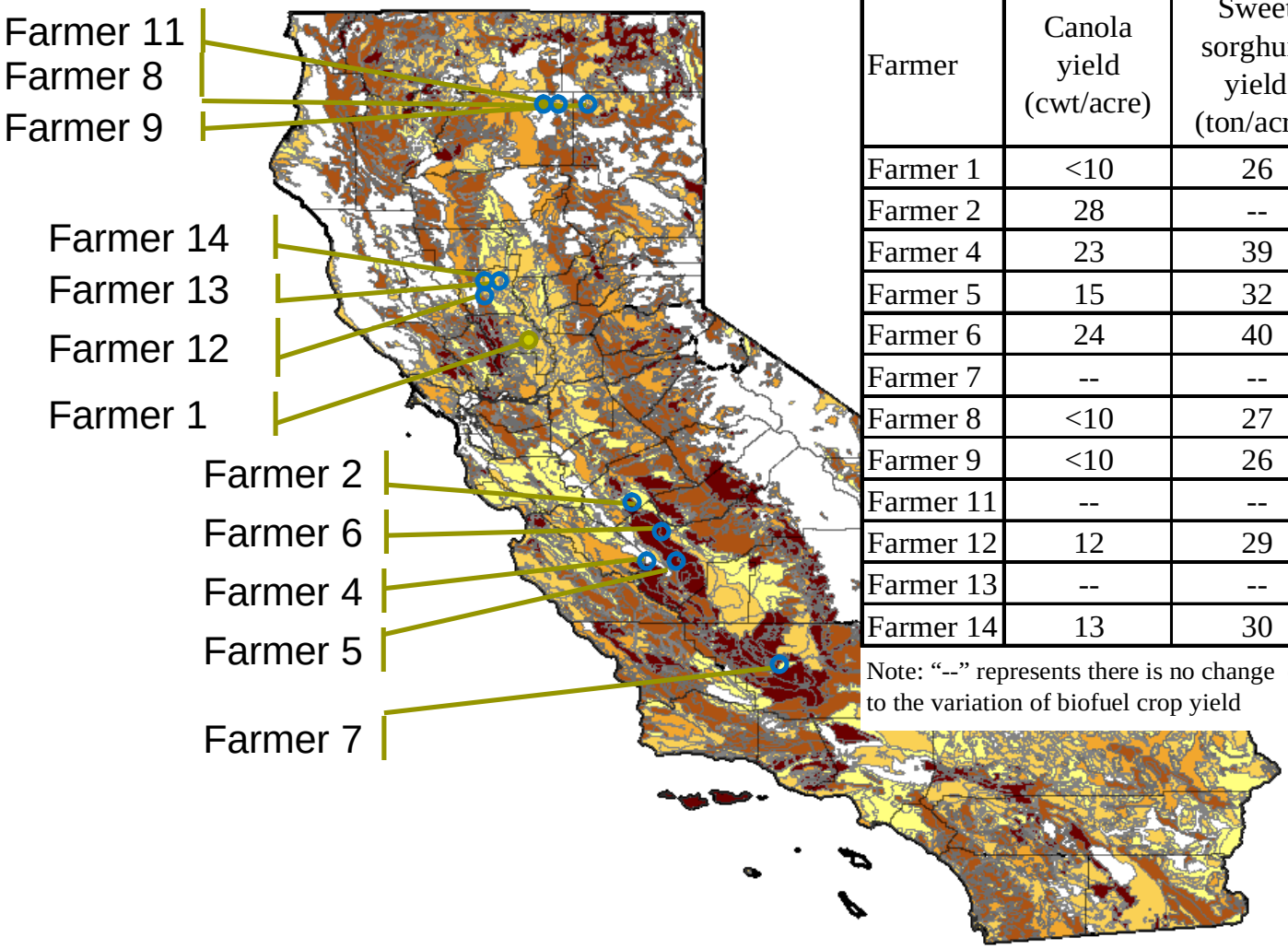
Figure 2. Trigger price of biofuel crops



Farmer	Canola price ($/cwt)	Sweet sorghum price ($/ton)
Farmer 1	12	16
Farmer 2	--	30
Farmer 4	--	28
Farmer 5	21	22
Farmer 6	--	28
Farmer 7	--	44
Farmer 8	14	18
Farmer 9	12	18
Farmer 11	--	32
Farmer 12	16	20
Farmer 13	--	30
Farmer 14	18	20

Note: "--" represents there is no change due to the variation of biofuel crop price

Figure 3. Trigger yield of biofuel crops



Farmer	Canola yield (cwt/acre)	Sweet sorghum yield (ton/acre)
Farmer 1	<10	26
Farmer 2	28	--
Farmer 4	23	39
Farmer 5	15	32
Farmer 6	24	40
Farmer 7	--	--
Farmer 8	<10	27
Farmer 9	<10	26
Farmer 11	--	--
Farmer 12	12	29
Farmer 13	--	--
Farmer 14	13	30

Note: "--" represents there is no change due to the variation of biofuel crop yield

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4. Continued work and expected results

- Create **representative farm** model for each subregion
  - Using GIS to divide subregions
  - Every subregion has its cropping pattern and corresponding acreage for all the crops
  - Accounting cost of each crop: http://coststudies.ucdavis.edu/current.php; Under the help of Dr. Maximo Alonso Valdes

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- Predict regional/subregional supply of bioful crop for each district under different market and agronomic conditions, especially market price and yield
- Connect crop production with environmental regulations and estimate those policy influences
  - Green House Gas emission associated with crop growth

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- Fertilizer and pesticide pollution
- Water use

- Mapping these results using GIS (land cover)

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4. CA should encourage indigenous biofuel production to do its share to reduce GHG without exporting all the consequences of doing so to other locations. This is partly a matter of ethics, but it will also have the best estimates of GHG effects for local systems.
5. The key to a successful transition to a low carbon future will be entrepreneurial innovation. The state should err on the side of encouraging such innovation.

Flexibility in adopting sustainability standards is the means to assure the greatest net benefit to Californians.

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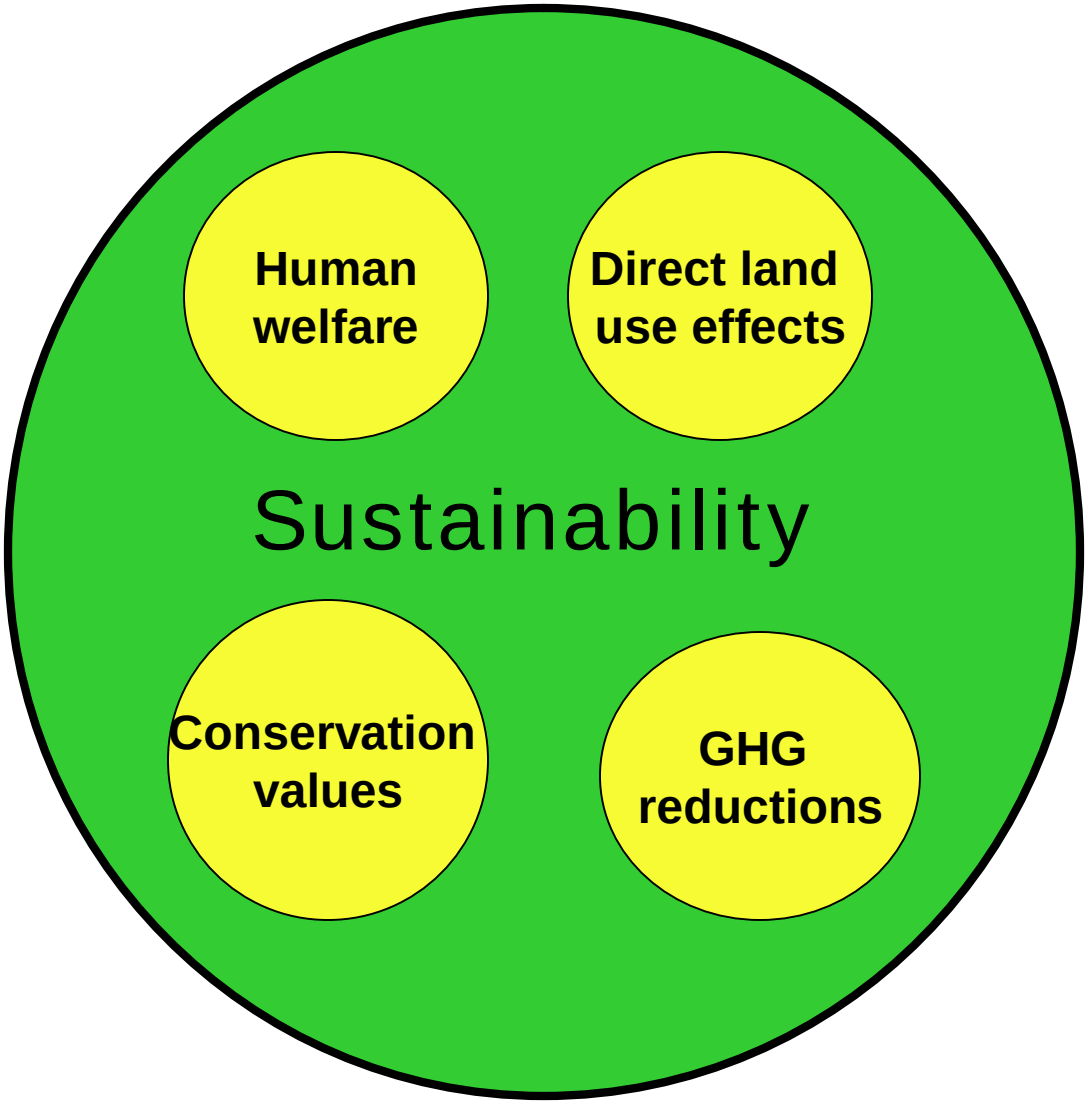

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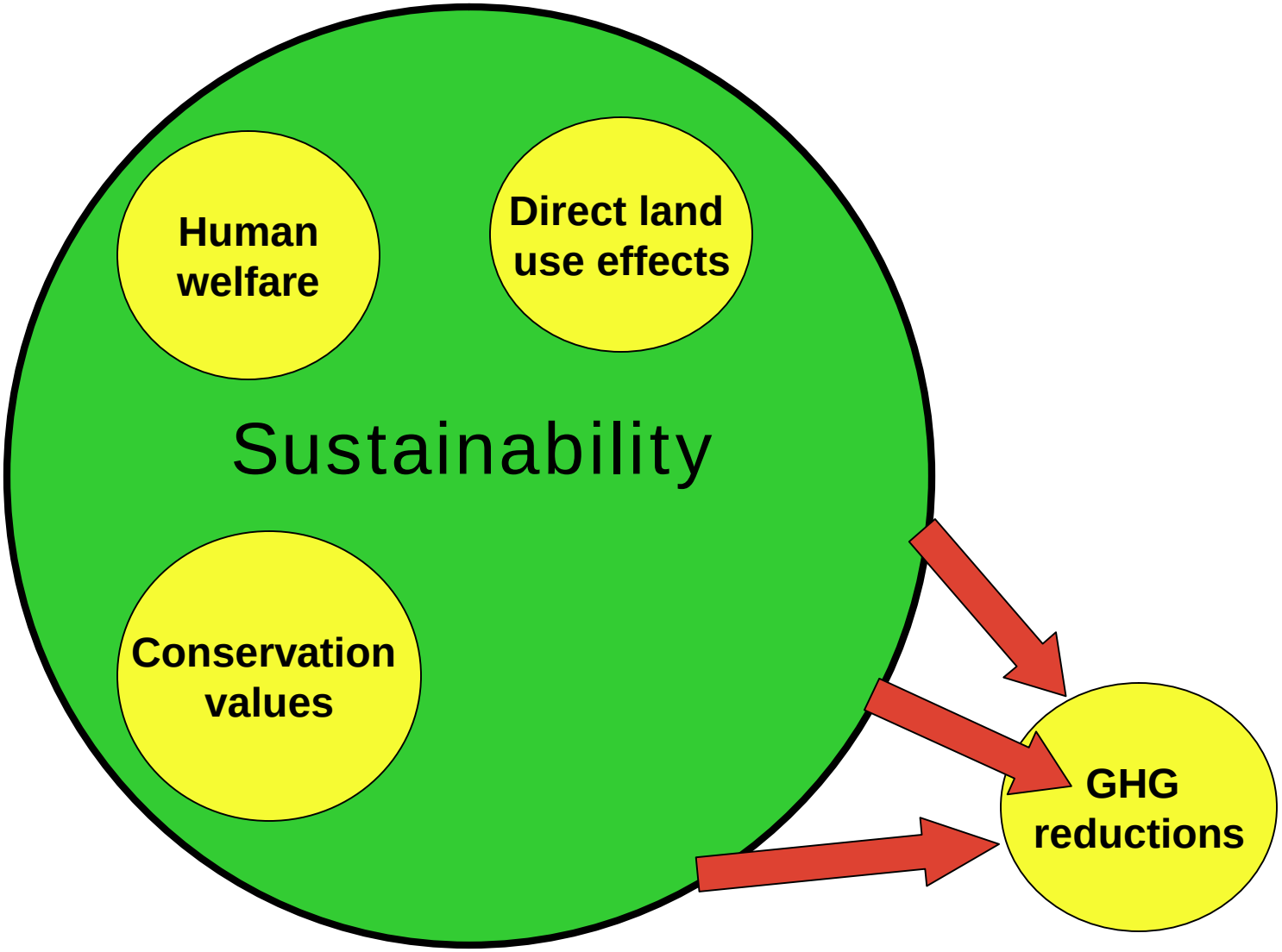

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Multiple reasons for biofuels- AB 32, the LCFS and AB 118 are not just GHG policies:

Alternative fuels from biomass will:

1. Diversify the supply of transportation fuels, provide more domestic sources and improve national security
2. Increase rural employment and wealth,
3. Reduce expensive crop surpluses
4. Distribute fuel refining
5. Benefit the environment by reducing petroleum use for transportation and reduce GHG increases.
6. Other benefits

(DOE, USDA, other sources-2004)

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How should we regulate?

Go slowly… Gradually increase sustainability standards as knowledge and public consensus improves. Make sure the public agrees (legitimacy).

Rely on the communities affected and competent parties (Like UC Davis and UC ANR [BEWG]) to develop BMPs and derive standards using BMPS.

Involve affected communities in consensus building about the terms, scale and application of social aspects of sustainability standards. This must be an on-going process because social preferences can change rapidly.

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How should we regulate?

Try not to constrain innovation, be willing to make prudent tradeoffs … remembering that carbon regulations will affect all aspects of modern life. The net long term public benefits from such innovation will outweigh short term losses of GHG benefits, if any, from overly restrictive policies.

Sustainability means flexibility, the ability to adjust to the unexpected.

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Oil production from tar sands in Alberta

An alternative to biomass use for energy

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