California's Climate Change Policy: The Economic and Environmental Impacts of AB 32

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OUTLINE
• Agriculture under AB 32
  • Rules and voluntary measures
  • Offsets
  • Suggested practices
• GHG emissions and costs of alternative crop practices
• Broad economic issues about agricultural impacts
• Conclusions
LAND IN FARMS IN CALIFORNIA

- Land in Farmsteads: 6%
- Total Cropland: 37%
- Permanent Pasture and Rangeland: 52%
- Total Woodland: 5%

Source: USDA NASS, 2007 Census of Agriculture

FOCUS OF THE PRESENTATION: ADAPTATION OF AGRICULTURE TO CLIMATE CHANGE POLICY

- This presentation does not deal with the effects of agriculture on climate change nor the effects of climate change on agriculture

- Instead, it focuses on the effects of climate change policy on California agriculture and agriculture’s adaptation to policy
AGRICULTURE IS A SIGNIFICANT CONTRIBUTOR TO CALIFORNIA GHG EMISSIONS

2008 CALIFORNIA GHG EMISSIONS BY SECTOR

By these measures Agriculture is about 1% of California GDP and 6% of California GHG emissions.

Total 2008 net emissions = 473.76 million tCO₂eq.
Source: ARB. 2010. Greenhouse Gas Inventory Data

CALIFORNIA GHG EMISSIONS FROM AGRICULTURE

Total 2008 emissions from Agriculture and Forestry = 28.25 million tCO₂eq.
Source: ARB. 2010. Greenhouse Gas Inventory Data
AGRICULTURE UNDER AB 32

- Agricultural emissions are not scheduled to be capped under AB 32
  - Policymakers decided that measurement and tracking was too difficult in agriculture
  - California Air Resources Board (ARB) assumed an emissions reduction of 1-3% by 2020 under Scoping Plan compared to business-as-usual (from about 29.8 to about 29-29.5 million tC02eq)
  - ARB further assumed 15% agricultural emissions reduction between 2020 and 2030
  - However, these reductions from agriculture are not included in ARB’s overall GHG reductions

TOP 5 CALIFORNIA FARM COMMODITIES, by value

1 – Dairy Products
2 – Greenhouse/Nursery
3 – Grapes
4 – Lettuce
5 – Almonds

Source: USDA
ONE SIGNIFICANT VOLUNTARY MEASURE

- Methane capture in digesters at dairies
  - Expected implementation: 2017-2020
  - Reduces emissions from dairy cattle by about 7.7% from 2008 emissions
- No mandatory policies under the current Scoping Plan

DIGESTERS ATTRIBUTABLE TO AB 32?

- Methane digesters have been around for decades
- No incentives/regulations directly in AB 32 or current plan
  - Will they be subsidized?
  - Some would be constructed anyway?
- ARB considers digesters to be a driving force behind GHG reductions in agriculture
SMALL INDIRECT UNDERTAKINGS

- Anaerobic Digestion (some agricultural waste enters landfills)
- ARB research program for reduction strategies for nitrogenous fertilizers
- Tire pressure maintenance
  - Reduces fuel use, raises productivity
  - Reduces soil compaction, lowering $N_2O$ emissions
- Perhaps future financial incentives for other GHG reducing practices

FARMING IS ALSO AFFECTED BY MEASURES ON PROCESSING OF AGRICULTURAL OUTPUTS AND MANUFACTURING OF AGRICULTURAL INPUTS

- Emissions from most food processing plants (tomato processing, wine, dairy butter/powder plants) will be capped under AB 32
- Input costs (eg. feed and fertilizer) will be affected by energy costs
IMPACTS ON FARMING FOLLOW FROM EMISSIONS CAPS ON ENERGY PRODUCTION

- Energy is a significant input to farm production, farm raw material processing and agricultural input production.
  - Examples of shares of energy costs in producers’ total operating costs
    - Rice ~ 9.2% or 16.7% including fertilizer
    - Wine grapes ~ 6% or 9.3% including fertilizer

IMPACTS ON FARMING FOLLOW FROM GHG EMISSIONS CAPS ON ENERGY PRODUCTION AND HIGHER ENERGY COSTS

- Food processing among most energy intensive industries in California
  - Only transport and agro-chemicals are higher
  - Milk is among most energy intensive within food processing
- When other, complementary, input costs rise in processing and marketing, the price offered to farm producers for raw materials will fall
- Impact may encourage shifts out of state where feasible, especially for livestock industries
EFFECTS OF HIGHER COSTS OFF THE FARM ON FARM INDUSTRIES

- For crop industries that are land dependent, shifting out of California is not likely
  - So, the result of higher processing and marketing costs is lower land values
- For other crops where California’s market share is high we expect some higher prices to buyers,
  - So, food prices rise, especially for fruits and vegetables
- Intensive livestock industries such as dairy or poultry are more mobile,
  - Therefore, some shifts out of state are likely

ALLOWANCES VERSUS OFFSETS

- Allowances
  - Facilities under the cap can trade “allowances”
  - Firms can abate emissions and sell their “allowances” or buy “allowances” from others and not abate
- Offsets
  - GHG reductions that occur outside of the cap
  - Sectors not under the cap can sell “offsets” to firms under the cap to meet their emissions reduction
**AB 32 SCOPING PLAN ALLOWS FOR SALE OF OFFSETS BY AGRICULTURE**

- Farming will be outside of regulated cap but can trade offsets
- No farm offsets are currently certified
- ARB’s examples of offsets currently acknowledged as potentially valuable:
  - Methane digesters on dairy operations
  - Cover crops or tillage practices used to build up soil carbon (organic matter)
  - Biofuels

**AB 32 REQUIRES THAT OFFSETS MUST BE:**

- **Additional**
  - Only reductions that would not have otherwise occurred can be counted. “Leakage” must be avoided.

- **Permanent**
  - Reductions should not be reversible.

- **Quantifiable**
  - Reductions must be demonstrable against a known baseline and follow standard protocols.

- **Verifiable**
  - A transparent verification process must be developed.

- **Enforceable**
  - Projects must be accessible to inspectors and those that do not comply with the regulations must be held accountable.
AB 32 SUGGESTED FARM PRACTICES

- Offsets include abatement, sequestration, and efficiency gains
- Abatement - removing or destroying greenhouse gases before release
- Livestock examples of abatement:
  - Converting methane gas in digesters
  - Biomass/biogas provides fuel or power
  - Feed additives may reduce methane production

SEQUESTRATION

(These are not important for California agriculture)
- Conservation tillage
  - Minimum of 30% plant residue on soil after planting
  - Currently employed on less than 2% of annual cropland in California
- Cover crops
  - Can improve soil health, add nitrogen, prevent wind or water erosion, or produce a forage crop
  - Not widely practiced in California because benefits are small and in practice it is expensive
EFFICIENCY

- Irrigation efficiency
  - Reduces energy to pump water and lowers nitrous oxide (N₂O) emissions (excess irrigation can raise N₂O emissions)
- Nitrogen use efficiency
  - Precision farming
  - Soil sampling to tailor applications
- Farm machinery
  - Reduce fuel use, increase efficiency

POTENTIAL GHG REDUCTIONS FROM ALTERNATIVE CROPPING PRACTICES

- Modeled emissions reductions were mostly attributable to sequestration, but were not permanent.
- Additional decreases in N₂O emissions were more modest, but were permanent.
- Implied 25% decrease in fertilizer with up to 8% decrease in yields.

Source: De Gryze et al. (2009)
POTENTIAL GHG REDUCTIONS FROM ALTERNATIVE CROPPING PRACTICES

• Changes in GHG emissions differed across location and crops
  • E.g. conservation tillage slightly increased GHG emissions for wheat (due to rise in N₂O) but decreased emissions for tomatoes
    Source: De Gryze et al. (2009)
• That modeling considers practices for production of each crop, not potential shifts of land and between crops

(We will come back to this point later)

POTENTIAL GHG REDUCTIONS FROM FARMING

• The simplest way to reduce GHG emissions from farming is to reduce farm production
• However, reduced emissions for offsets are not the only objective of agriculture
  • Food, fiber and foliage remain useful contributions
• Therefore, it is important to consider measuring GHG reductions in terms of emissions per unit of output of a value indicator not simply per acre
ALTERNATIVE PRACTICES FOR RICE

- Rice is a significant GHG contributor in part because of methane emissions
- Anaerobic decomposition of biomass emits methane
- Reduce methane by:
  - Draining fields mid-season
  - Using less winter flooding
to decompose straw residue

ALTERNATIVE PRACTICES FOR RICE

- Consider economics of alternative practices
  - Cost to growers, compensation to adopt?
  - Compare to GHG reductions to trace out GHG reductions per dollar of reduced returns
- Study nearing completion examines practices across more than six thousand fields in the Sacramento Valley
- The biggest cost of alternative practices is foregone production from yield reductions
ALTERNATIVE PRACTICES FOR RICE

- Many practices have at most modest GHG reductions
- Withdrawal of mid season flood water is not among the most effective practices to reduce GHG emissions per ton of rice
- Alternatives to reduce winter anaerobic straw decomposition seem to lower GHG emissions
- Substantial heterogeneity in emissions across fields by soil type in the California rice belt

AN EFFECTIVE AB 32 MAY INCREASE GLOBAL AGRICULTURAL GHG EMISSIONS

- AB 32 rules can lead to increased GHG emissions from global agriculture
- Agricultural markets are global and Californians will continue to consume food
- Raising costs here will shift food production out of state, and not reduce global emissions
- Production practices elsewhere are often more land intensive and therefore more GHG intensive
EFFECTIVE OFFSETS PAYING FOR CHANGES IN PRACTICES CAN INCREASE CALIFORNIA GHG EMISSIONS FROM AGRICULTURE

- Offsets for practices that are certified by crop do not account for shifting land across crops, and there are big differences by crop
  - If a certified practice allows payment for offsets for, say, tomatoes, that will raise tomato revenue and encourage more acres of tomatoes.
  - The result would likely be fewer acres of competitive crops like wheat with a net increase in GHG emissions from agriculture even though offsets are certified and verified

CONCLUSIONS

- This presentation did not address the effects of climate change on agriculture or the adaptation of agriculture to expected climate change
- Nor did it consider the contributions of agriculture to GHG emissions in any detail
- Rather, it focused on the effects of climate change policy on California agriculture and agriculture’s potential responses to AB 32 implementation
- Agriculture faces the similar potential uncertainties and impacts of higher energy prices both on farming directly and through farm inputs and post harvest processing and marketing