January 6, 2022

California Air Resources Board
RE: Public Workshop to Discuss Potential Future Changes to the LCFS Program
1001 I Street
Sacramento, CA 95812

Please accept the following comments on the "Public Workshop to Discuss Potential Future Changes to the LCFS Program:"

1. **CARB staff comments on a stakeholder request to reevaluate Biofuel LUC:**
   "*One such request is to re-evaluate land use change values. To date, staff has not seen a consensus in the literature that warrants directional changes in existing land use change values. Staff also believes that continuing to include strong land use change CIs in the LCFS sends the correct policy signal to avoid and/or transition away from the use of crops to more sustainable feedstock and fuel alternatives that provide much more certain emission reduction benefits. However, staff is open to considering new data and research related to this topic as science evolves in the future".*

Stakeholder Response:
These CARB staff comments lead us to believe that staff is not aware of two recent research papers on Land Use Change:

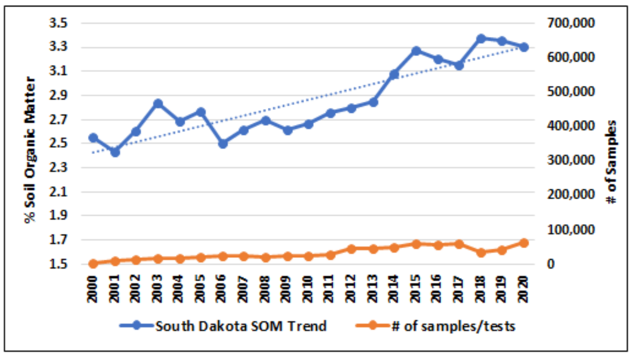
1. **"Biofuel Impacts of Food Prices Index and Land Use Change"**
   https://www.sciencedirect.com/science/article/abs/pii/S0961953419300911
2. "**Critical Review of Supporting Literature on Land Use Change in the EPA's Second Triennial Report to Congress"**
   https://ethanolrfa.org/file/1834/SIUE-Review-of-Land-Use-Change-Literature-07-2019.pdf

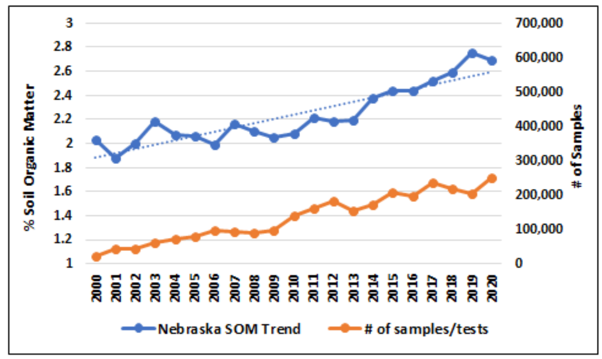
Land Use Change related soil carbon and nitrous oxide emissions have been part of Biofuel GHG accounting due to concerns regarding the 8-10 fold expansion of corn ethanol in the 2006 to 2015 time period. Experts and economic models predicted that this rapid increase in corn use for ethanol fuel would have these consequences (from paper #1 above):

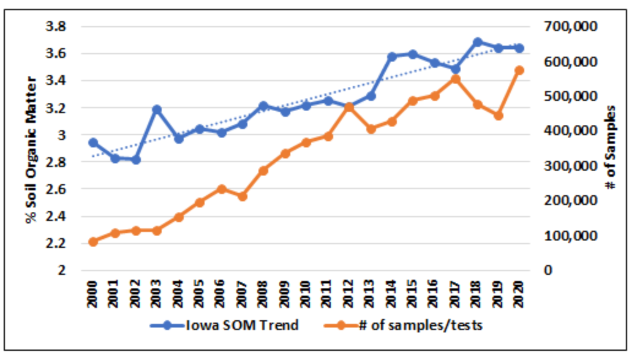
1. As fuel demand for corn increases, soybean, and wheat lands switch to corn, and prices increase by 40%, 20%, and 17% for corn, soybeans, and wheat, respectively.
2. U.S. agricultural exports would decline sharply (corn by 62%, wheat by 31%, soybeans by 28%, pork by 18%, and chicken by 12%).
3. When other countries replace U.S. exports, farmers must generally cultivate more land per ton of crop because of lower yields.
4. The US will bring 10.8 million acres of additional land into agriculture.

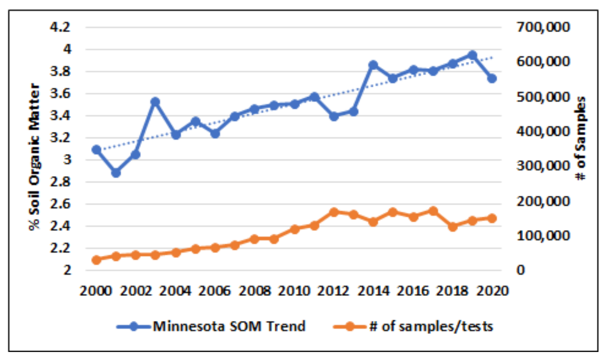
These predictions were all quite logical and represented the best estimation and modeling by qualified experts. Now however, we do not need to rely on expert and economic model estimations, and researchers have been able to determine the actual long term impact of this rapid growth in biofuel production. “The food price inflation rate indicates little or no change, feed grain and meat exports have continued to grow, and total cropland in the U.S. has not increased, even though some LUC research papers that used automated land use classification from satellite images have indicated otherwise. Critique of this flawed satellite image analysis is included in both papers.

The CARB and EPA LUC assessments also assume that soil carbon stocks continue to degrade in fields producing biofuel feedstock crop, such as corn and soybean, across the Mid-west, and that is a key modeling factor when the final LUC CI is determined. However, SOM trend data from multiple large Soil Testing Labs indicate that Soil Carbon stocks are increasing in cropland fields across the Mid-west. See following charts. Note that these data represent more than 12 million soil samples/tests across these four states over the past 20 years! We do indeed have land use change related soil carbon change from Biofuel feedstocks, and it is positive, not negative.









Source: Jim Fasching, Mid-West Laboratories, Omaha, NE

Furthermore, the CARB/LCFS Regulators/staff have an appropriate policy/tool they could use to help regulate Land Use Change. That would be to allow for biofuel feedstock accounting at the farm level, so biofuel feedstock producers would have an incentive to minimize LUC, if that were to become an issue.

For your convenience, following is the Abstract and Conclusion of paper number 1:

Abstract

Food price and land use data over an extended time period have been examined to identify possible correlations between biofuel production and food price or land use changes. We compared the food price index before and after the biofuel boom in the 2000s to evaluate biofuel's impact on the inflation rate. We found that the U.S. food price inflation rate since 1973 could be divided into three distinct regions. The inflation rate was lowest at 2.6% during 1991–2016, which encompasses the biofuel boom. Among many factors, continuously rising food production per capita was identified as the likely

cause of low food price inflation during this period. The US exports of corn have not declined since the 1990s and soybean exports are rising at a steady rate. Among several variables tested as a cause of food price index increase, crude oil price had the highest correlation. We also manually verified the automated land use classification of satellite image covering 664 km^2 in three selected areas in the US. We found that 10.90% of non-agricultural land was misclassified as agriculture, whereas only 2.23% of agricultural land was misclassified as non-agricultural. The automated classification showed an 8.53% increase in agricultural land from 2011 to 2015, while the manual classification showed only 0.31% ($\pm$ 1.92%) increase. This result was within the margin of error alluding to no significant land use change. We concluded that automated satellite image land use classification should be verified more rigorously to be used for land use change analysis.

Conclusion

Impacts of biofuel on food price and land use change are difficult to observe or measure directly and hence they are often simulated using economic models. However, economic models may fail to incorporate significant non-economic factors, and that model parameter values may not be representative making the model predictions inaccurate. This paper compares the model outcome predicting the impact of biofuel to the real-world data.

Economic models predict that biofuel will increase the food price. A comparison of the average increase in commodity price index (CPI) showed no evidence of a higher rate of CPI for food before and after the biofuel boom of 2000. The food price inflation rate from 1991 to 2000 (before significant biofuel production era), and from 2000 to 2016 (after the biofuel fuel boom) were not significantly different from the 2.6% rate of average inflation for the entire range. Among several factors contributing to a relatively lower inflation rate compared to recent history, increasing per capita food production and the higher feed production as a co-product of biofuel were pointed out as significant factors. Although corn and soybean prices were rising temporarily during the biofuel era, the price dropped sharply after 2012–2013 despite increasing biofuel production. This indicates that biofuel may not be the real cause of corn and soybean price increase. Another contradiction in model prediction is that, despite the increasing amount of biofuel production, the US corn and soybean export has not declined. While US exports of corn and grain, in general, had not changed significantly since 1991, oilseed exports had been increasing at an average rate of 1.2 million MT/year. This phenomenon was attributed to growing per capita grain and oil crop production. Corn and soybean production per capita grew at an annual 2.3% and 2.8% respectively between 1991 and 2016.

Globally, it was found that the food price index (FPI) had the highest correlation with crude oil price and 96% of the variability could be explained from the crude oil price and world population. The correlation between the FPI with crude oil price was causal at a 95% confidence interval. Looking at these discrepancies between model predictions and observed data, we concluded that the assumptions in economic models predicting the impact of biofuel on food prices and indirect land use change needs to be revised, and carefully assessed to see if the model captures the complex real-world dynamics adequately by validating the results against real-world data. Additionally, the causality of correlations must be justified and tested to ensure that predictions remain valid for the foreseeable future. This paper also evaluated the accuracy of machine classified satellite images land coverage map. Although these resources were not built for land use change research, they are being used for that purpose. We analyzed three selected areas in the US with a total of 664 km2 from a diverse geographic location, and manually verified the CropScape CDL automated satellite image land use classification and NLCD image data. We found an average of 27.86% of total land cover classification error. The misclassification errors were not random, 10.9% of the nonagriculture land was classified as agriculture whereas only 2.23% of agricultural land was classified as something else, so a net 8.66% of the non-agriculture land was classified as agriculture land. This observed phenomenon was attributed to higher a priori probability of agricultural land compared to other categories to classify a border pixel.

Automated CDL image classification from 2011 to 2015 shows an average increase in agriculture land of 8.53 km2, which is 1.28% of the land area considered. When the manually verified land classifications were compared, the agricultural increase was only 0.31 km2 with a 95% confidence interval of±2.7 km2. This corresponds to 0.05 ± 0.41% of the land area. Since a 95% confidence interval of the change in the agricultural area included zero, it was concluded that land area change to agriculture was not statistically significant. Based on our findings, it was concluded that satellite analysis is not an accurate method of determining land use change. In summation, our findings indicate that there has been no significant change in US food prices due to biofuels and biofuels have not caused any significant agricultural land use change. We conclude that machine classified satellite images do not have needed accuracy yet to be used for land use change analysis.

2. **CARB staff comments on a stakeholder request to allow for site specific biofuel feedstock carbon intensity calculations….addressing potential GHG "leakage:"**
   "Another request is to allow for consideration of site-specific agricultural inputs in fuel pathway carbon intensity calculations. Staff is interested in stakeholder input on how to address potential GHG leakage. For example, it is possible that projects that adopt advanced farming practices with lower emission impacts would report site-specific data under the LCFS while projects with emission impacts higher than the average for the specific commodity/crop might choose to report average values. Staff is interested in seeking input on whether default farming values need to be adjusted to mitigate the impact of any imbalances that may result by the consideration of site-specific agricultural inputs."

Stakeholder Response:
GHG "leakage" is a concern, but it needs to be acknowledged that GHG leakage is very common and significant in current LCFS pathway GHG accounting. Examples: 1) The lowest CI corn ethanol currently comes from western Corn Belt regions with large cattle feedlots and where irrigated corn is the norm. Like all corn ethanol going to LCFS market, these Western Corn Belt corn ethanol plants use *"Mid-west average corn feedstock carbon intensity."* However, because they rely on irrigation, their energy use and GHG emissions associated with irrigation are not fully accounted for and are higher than "Mid-west average" and not insignificant, because irrigation is quite energy intensive. This obviously results in unearned carbon reduction credits for those ethanol plants.

2) Even dryland corn production in Western Corn Belt regions benefit from use of the "Mid-west average" corn feedstock CI. Corn production energy use is calculated in the GREET model on a "per bushel of corn production" basis. The Mid-west average is about 8,800 btus per bushel of corn when corn yields 178 bushel per acre (GREET 2021 Model). But fuel used in tractors, sprayers and combines by farmers is not based on bushels of production, it is based on surface area (acres covered). Dryland corn production in Western areas of the corn belt is typically about 80 to 100 bushels per acre, and those corn producers likely use substantially the same amount of diesel fuel, gasoline and other farming energy per acre as "Mid-west average" corn producers, but produce only half as many megajoules of ethanol energy per acre. Thus, in actuality, they use approximately 17,000 btus per bushel of corn

production. And again, this results in unearned carbon reduction credits.

3) At the same time the high yield corn producers in the "rain fed" Central Corn belt are getting penalized for a higher CI than actual. Producers that regularly achieve 200-250 bushel per acre yields use substantially the same amount of energy per acre in their tractors, sprayers, combines, etc. as do 80-100 bushel per acre producers in the Western Corn Belt. So, their true corn production energy CI is substantially below "Mid-west average". Lime use, Herbicide use, and Insecticide use, are also calculated on a per bushel basis in the GREET Model, but on real corn farms, lime, herbicides, insecticides, and to a lesser extent fertilizer use rates, are based on a per acre basis, not a per bushel/per megajoule basis.

4) Soil Nitrous Oxide emissions are a major part of corn feedstock CI, but N2O is greatly influenced by soil water balance. Corn production regions that receive more growing season rainfall than is needed/used by crops have much higher direct (nitrification and denitrification) N2O emissions and indirect (volatilization, runoff and Leaching N losses) related N2O emissions per unit of N fertilizer than do regions where growing season precipitation is equal to or less than crop water needs. Again, another "advantage for some regions, disadvantage for other regions" and the associated "leakage" that occurs when applying a "Mid-west average" for a U.S. corn production.

There are no easy answers to these issues, but farmer specific biofuel feedstock production CI accounting aggregated into a corn ethanol plant CI is the only plausible way to address the existing LCFS leakage issues and any future leakage issues. And just as LCFS Ethanol Plant specific CI accounting has spurred low carbon technology investment and management at those facilities, the best way possible to drive biofuel feedstock production CI lower is to incentivize/credit low carbon biofuel feedstock production in the same manner.

Sincerely,

Ron Alverson
Lake Area Corn Processors/Dakota Ethanol, Wentworth, SD