Agricultural Modeling Team (AMT)
Meeting Minutes

November 9th, 2023

09:00 AM – 11:00 AM

Meeting Materials

Summary of Actions and Decisions

Decision: The AMT approved the October 2023 minutes.
Action: Please email Joseph Delesantro (jdelesantro@chesapeakebay.net) and Tom Butler (butler.thomas01@epa.gov) if you have any relevant crop yield data that can be used for crops with partial or no data. (*See slide 8 of linked presentation for details.*)
Action: **VOTING MEMBERS ONLY:** Please complete **this poll** by **COB Wed, Nov 22,** to provide feedback on which crops might share yield trends.

Meeting Minutes

Statement of purpose:

To evaluate the crop yield and land uses in CAST and discuss potential alternatives for Phase 7.

Announcements

- At the October AgWG and WQGIT manure eligibility was discussed for Phase 6 only.
    - Consensus approval was reached at both the AgWG and WQGIT.

Introduction: 09:00-09:05 [5 min (Zach Easton, Virginia Tech)]

Zach asked for approval of the October minutes and took attendance.

Crop Yield trends 09:05- 09:45 [40 min (15 min presentation 25 min discussion) (Joseph Delesantro, ORISE, Tom Butler, EPA)]

The group continued to discuss progress being made to improve long term crop yields gathered from USDA data. This includes multiple potential approaches for estimating yields from the Five-Year Census of Agriculture using correlations to crops with existing annual yield data.

Discussion
Hunter Landis (in chat): Are there estimates of crop acreage for the list of incomplete crops?
Joseph Delesantro: Yes and no. Some of these are in the digitized data, they don't have crop yields but they have acreage. All of these have acreage presented in the census of ag but it might not be captured in the digitized data. So for some, yes, but it's only a handful of crops in the partial and none categories where we have both yields and acreage.
Alex Soroka (in chat): Do we have datasets for all the variables in black? How many do we have at hand?

Joseph Delesantro: I've been working through the soil predictor data for now. These are summarized for the crop land within counties within the CB growth regions and within the states. Then I'll go through the topographic variables, and then it's just a matter of identifying geospatial weather data.
Alex Soroka: Do we have the topographic wetness index?
Joseph Delesantro: I will be completing a separate topographic analysis which I'm familiar with through my work in North Carolina.
Olivia Devereux (in chat): The list shown was taken directly from the Ag Census for acres. The digitization backstory is that the people census used to do the agricultural census until 2002. With 2002, USDA took over the responsibility since they are the subject matter experts. The pre-2002 censuses are not available from the US Census or USDA in digitized form.
Dave Montali: Regarding the survey, how should we think about relating crops that have complete and incomplete data? Are there crops on there that don't receive nutrient applications, like christmas trees?
Joseph Delesantro: I tried to remove crops that don't have nitrogen application or yields. Regarding the surrogate crops, we're interested in crops that might have similar trends in yield over time (e.g., sweet corn could be similar to the trend for corn grain or corn silage). Then we could take that trend where we have the data and apply it to the crops that we don't. It'd be a rough estimate but that's where these numbers come into account.
Olivia Devereux (in chat): Is it an option to sum acres from these crops before inputting to CAST? Then a common yield could be used for that category.
Dave Montali: If you have 90% of acreage and N application, maybe there's a better way to deal with these other ones than trying to do another 50-75 assessments of yield. We could hold them constant or something, but maybe that's for another discussion at a later date.
Gary Shenk: We're going to be looking at the total area of cropland that the land data team finds through satellite data. If we don't have a complete accounting of all the crops, we'll be assigning fertilizer applications in the not the best way from a mass balance perspective. We want to include everything so we don't run into local mass balance problems. Some estimate of yield and trends is better than nothing because if it is changing over time, we want to account for uptake.
Dave Montali: I was thinking more along the lines of grouping them and if there's nothing genetic going on relative to yield then maybe we hold it constant. Just an idea.
Gary Shenk: If the answer is constant, then that's great, there's no problem with that. But we want to know if it's likely increasing.
Olivia Devereux: Maybe we don't need to keep asparagus and artichokes separate, they could be grouped together just like we have a grouped load source that encompasses vegetables. Maybe we group together and say overall this is the acreage of these crops and then handle the yields the same.
Mark Dubin: The group has previously identified several past USDA-NASS Census reported crop yields which reflected lower than expected yields due to negative weather influences. These reports have a dampening effect on the increase of crop yields in more recent years. Given the variability of yields from year to year, and the gradual increase of yields over time, previous data evaluations by the partnership have recommended the use of annual reported data where possible to offset these potential Census data abnormalities while acknowledging there are data limitations.
Robert Sabo: Referring to the trend inference model on slide 10, this model will only be needed for the remaining 9% of cultivated cropland and 5% of fertilizer application, roughly. Is that correct? You don't need a model for corn or soy because we have census and NASS data?

Joseph Delesantro: No. Our goal with this estimate is to take the 5-year census dataset and to generate an annual estimate of yields. With the 5-year yield data we might only have 10 or 12 data points over our entire target region when taking into account missing data or years when certain crops weren't grown in that county for example. So the annual estimate will give us more to establish a solid trend on and reduces the possibility that the data is skewed by good or bad years.
Robert Sabo: The 13 survey crops will have the strongest yield trends. It seems like this model can capture the interannual variation in yields due to climatic variation and spatial paths due to soil characteristics, but how will it capture a trend due to improvements in cultivation practices or genetics?
Joseph Delesantro: Good point. One way to do that is just by adding additional parameters to the model. This is just a list of environmental variables.
Zachary Easton (in chat): GHCN is an option for serially complete weather data, it goes back to the 1890s but was relatively sparse coverage until the 1950s, density has increased over time. Good place to start anyway. https://www.ncei.noaa.gov/products/land-based-station/global-historical-climatology-network-daily
Mark Dubin (in chat): Where the group identifies lacking yield data for specific crops, there may be data available from alternative sources to fill that need.
Alex Soroka (in chat): Frontiers | Historical Trends in Sweet Corn Plant Density Tolerance Using Era Hybrids (1930–2010s) (frontiersin.org)
Jess Rigelman: Right now, we're talking about application rates. In the real world, are yields used to factor into application rates for all crops? Only asking this because it's a lot of work to get a complete yield dataset for 100 crops and if we're only using yield to factor into application rates, then if yields aren't a determinate of application rates then we don't necessarily need that information.
Joseph Delesantro: Good question of what is driving application for most of these crops. Our assumption is if the yield is increasing over time then likely additional nutrient application will be required.
Gary Shenk: Correct, if there's a trend in yield there is likely a trend in application.

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Land Uses in CAST 09:45-10:45 [60 min (15 min presentation 45 min discussion) (Helen Golimowski, Devereux Consulting)]

Helen provided background information on how current BMPs are reported and the level of detail for land uses which is used to report practices. The group was then asked to give feedback on whether maintaining increased detail related to land uses is necessary given BMP reporting practices, including the following discussion questions:

- What load sources do we need for BMP reporting in Phase 7?

- What level of detail can the ag sector track?
- What can the data reporters report?

Discussion

Olivia Devereux: Looking at how the model is used - it is only spatially mapped for 2 categories and it's only used for the default BMP reporting, so I would like to think about if we're over parameterizing and if the way we're doing it now is useful?

Robert Sabo: My understanding is that you're taking all the 90 crop types and aggregating them into 5 or 6 crop types through a weighted average approach? Is that correct?

Gary Shenk: Yeah that's how you can think about it. If we have fewer land use types or load sources, it doesn't mean we're not considering all the crops, just how many different land uses we group them into. There are really only 2 differences between load sources - how we apply BMPs and what the loading rate is from them.

Peter Claggett: There is a tie back to the Phase 7 mapped land use. Right now we are planning to map three load sources for agriculture: pasture, crop land, and animal feeding operations. That would be down to the NHD catchment scale. So that will make the spatial disaggregation from BMPs reported at a coarser scale, like a county scale, down to the NHD catchment more accurate than it currently is in Phase 6, but it's not adding that much flexibility into the types of load sources you have spatially.

Dave Montali: There is a disconnect between the land use mapping and ag census when mapping pasture and hay. The land use puts pasture with hay, the ag census treats hay as a crop.

Peter Claggett: Correct.

Dave Montali: Is that a major obstacle for us? That doesn't keep us from saying we ought to have pasture hay crop and animal feeding operations as our load sources, right?

Peter Claggett: Right.

Tom Butler: Do any of the states have input on this?

Dave Montali: In WV (non-regulated ag state) - we don't have the specificity even if we wanted to. Helen noted that not all the states do it, so there may be some states that have better info but don't want to report it that way because of cutoff issues. If it is true that up through now everyone reports these BMPs on a default basis, then this model is not being used with the specificity of having a bunch of different load sources.

Tom Butler: Good point. In terms of Phase 7 are we trying to look at more detail or less detail?

Kate Bresaw: In PA, we ran into cutoff issues that Dave mentioned. We have more specific detailed information, but we report at the county level to avoid those cutoff issues. We want to keep it at the county level because we have accountability to our county level stakeholders that we need to maintain.

Olivia Devereux: What about the land use part? Do you know if nutrient management plans are going on corn or grain or soybeans, for example?

Kate Bresaw: We don't track that specificity in the database, it's part of the nutrient management plan itself.

Cassie Davis: Same in New York. We use the county scale to avoid cutoff.

Tom Butler: Do you track specific crops?

Cassie Davis: Upper Susquehanna Coalition does all the tracking for us and Emily Dekar isn't online right now, but I think they can select which land use they are reporting on.

Elizabeth Hoffman (in chat): Same in Maryland, we'd advocate for higher aggregated groupings of land use, we also experience cutoff issues if we try to get too specific and it's challenging.

Clint Gill (in chat): Delaware also does not track specific crops.
Chris Brosch (in chat): And at county for same reason.
Tom Butler: Any idea what a higher aggregation might look like? Do people see value in increasing specificity or staying at the level we're at?
Joseph Delesantro: In my perspective with the different crops, no problem aggregating the crops, but question of how we go about doing that. Need a methodology for that.
Dave Montali: My gut is saying we should categorize into crop, hay, and pasture, but then you think about Christmas trees and orchards, maybe there's more to determine which categories those are put into. Also a problem with ag open space.
Gary Shenk: I agree with Dave. Need to think about this. I like simplicity since it tends to stabilize the predictions we make using this model. For a historical perspective - we've always had one crop land use that had everything on it. That has gone back and forth between putting more detail with land uses and going back to simplified versions. Model tends to be more stable when we swing towards simplicity.
Robert D. Sabo (in chat): the specificity seems fine, but just acknowledging specific crops matter little in the mass balance (or the model is not sensitive, especially after the weighted average)
Mark Dubin (in chat): One underlying data issue of the level of detail is related to the basis of data. One example is for "D" county scale data from USDA-NASS which is elevated to the state scale and reallocated by the CBP back to the county scale. Another is the variability of reporting from producers to USDA.
Tom Butler: It sounds like there's a desire to move towards simplicity and have a few composite crops. Is that where the group is headed?
Robert D. Sabo (in chat): If we do that then we can leverage specific categories in NASS.
Jess Rigelman: I want to make sure we're all talking about the same thing. We talked about crops and yields during the first presentation, but now we are only talking about grouping those crops into land uses. This is not a conversation about composite crops that we'd be getting yields and application rates for, but rather, how we aggregate individual crops (whether that stays at 100 or is reduced) and gets into land uses for BMP reporting. Helen's presentation is asking us if we should just have 3 land uses for however many crops we decide to have, and how we aggregate those for how we report BMPs. It is not referring to the parameters of how we calculate loads for legume fixation and application rates, etc.
Tom Butler: Maybe we can add another survey question to see if there's a desire to reduce or maintain the number of land uses from our members.
Peter Claggett (in chat): Here are the mapped (1-meter resolution) agricultural land uses for Phase 7. We will likely withhold information on animal operations from the public but still use it in our models.

Agriculture
80 Cropland Barren
81 Cropland Herbaceous
82 Orchards and Vineyards Barren
83 Orchards and Vineyards Herbaceous
84 Orchards and Vineyards Shrubland
85 Pasture/Hay Barren
86 Pasture/Hay Herbaceous
90 Agricultural Structures
91 Animal Operation Impervious
92 Animal Operation Barren
93 Animal Operation Herbaceous

94 TC over Agricultural Structure
95 TC over Animal Operation Impervious

Robert Sabo: What is the difference between cropland herbaceous and pasture/hay herbaceous?

Peter Claggett: Herbaceous is the land cover. But then how it's managed determines the land use, so whether it's managed as pasture or cropland, will determine which one of those categories it goes into. We use the NASS cropland data layer to determine that.

Mark Dubin: Some of the conditions like cropland barren vs herbaceous can change over time and pretty rapidly. So I didn't know how you were looking to address that as far as land use.

Peter Claggett: These are among the 62 land uses. This is the full land use classification that will inform P7. I'm not proposing each of these, like cropland barren or herbaceous, load differently in P7. They will both be aggregated up into cropland. We just specify between the two for other uses of the data, potentially outside the CBP. They will be aggregated for P7 based on your recommendations.

Tom Butler: We can change the land uses and loading rates for P7 if we choose to do so.

Dave Montali: When we did Phase 6, we started with assumptions on how crop v pasture v hay acted and then used this detail to expand into different types of crops. I see crops loading much higher than pasture and hay. Not sure what the ratio between pasture and hay is, it seems to me like there is a lot of ag land that is open space that is relatively low loading compared to the other two. For WQ purposes, we could probably start with loading rates for the broad LU classes and be just as good as we are now.

Mark Dubin: We're starting off with a baseline dataset and aggregating it up into a larger grouping that's relative to the load or number of acres. Maybe we can still utilize this baseline but bring it up into more combined land use units.

Ken Staver: Can you explain again why we want to change this?

Tom Butler: We want to improve this if we can because right now we track to a level of specificity that no one reports BMPs to.

Ken Staver: Targeting is a big thing that the CESR report emphasized. It seems to me that there should be an option to target and have programs go after the high loading areas and get credit for that if they choose to.

Zach Easton (in chat): Agreed.

Candiss Williams (in chat): Is the model sensitive to this?

Robert D. Sabo (in chat): How is the mass balance maintained when you go from NASS/CENSUS reported acreage/yield values and relativizing it to the USGS land use product?

Candiss Williams (in chat): The NASS land use would be most ideal.

Robert Sabo: Good point about targeting, Ken. First, with the remote sensing products that USGS is developing, there are certain types of crops that we have very high confidence using the spectral imagery, so that could potentially be used to identify these subcategories for cropland. But in regard to the aggregation piece that you raised, even if we ended up keeping these general categories that are already there, since the Bay Program is compiling the information on corn yields, soy yields, etc, we could identify which crop type is driving that weighted average within these different categories.

Tom Butler: What is feasible for targeting and what isn't from a jurisdictional perspective?

Kate Bresaw: Specifically for NM, we are not recording in our database the planned crops, though they are in the NM plan. We are not recording the crops that were actually planted in our inspections. Our regulations don't require those records. We track whether they are following their plan and are compliant. But we don't record the plan itself or the planted crops. Database would need a structural change.

Ken Staver: I understand that nutrient management plans are not by crop, they are by farms or fields. But when they get credited, maybe the crediting has to be different for different crop types even though the practice is reported across a certain number of acres. It doesn't have to be either/or. Components need to be communicating. Don't mean everything needs to be collected on a crop by crop basis.
Olivia Devereux: This discussion is solely about BMPs and the level they can be reported at and the land use loading rates. We can keep 100+ different crops for calculations if we choose to.
Ken Staver: There's like 7 that are 97% of the acreage. When we're talking about the major crops, I think they need to be kept as identifiable as possible.
Candiss Williams (in chat): Could you do the top 5 or 10 crops and then lump the remaining?
Tom Butler: It's slightly different. In our first presentation, Joseph noted we have around 101 crops and are trying to get yield data for those to determine application rates. This discussion is separate. When BMPs are applied, they are distributed on a land use/load source which then gets distributed to the crops that Helen has listed. We have existing aggregations and if those can be further changed then we can look at that, but we're not trying to arbitrarily aggregate things.
Cassie Davis: In NY, for ag nutrient management row + hay, if we chose leguminous hay and then reported 100 acres on that, but then a portion of the model that we reported to only has hay or pasture, then it wouldn't get reported as a BMP, it would be cut off. And that's why we're reporting at that larger row + hay scale.
Olivia Devereux: If we have all the crops that map to two specific loading sources, e.g, specialty crop high and specialty crop low, and if you don't know the difference between them and think we are parsing things out too much which results in excess BMPs for that land use and that's why you're reporting on that combined land use loading rates, then it may be when we do the estimations of acres and all those things at the crop scale, perhaps we combine ag specialty crop high or low. We don't have data at that scale because of confidentiality purposes in the ag census so it does produce a challenge. We could go larger with the load sources or larger with the geography to avoid this, which seems to be what people are doing now.
Dave Montali: Another confounding factor is with double cropped land and what they are reporting to our model.
Olivia Devereux: I think the double cropped issue is a separate one and has to do with acres that have more than one crop in a given year so probably a different problem than just general categorization.
Robert D. Sabo (in chat): I took a look at MD's nutrient management plan form and they do have to report their planned crop acreage
Chris Brosch: [referring to Example BMPs slide]. Not sure why these are categorized and named the way they are. The 14 load sources listed beneath Ag Nutrient Management named row + hay does not make sense. Also not sure why silage without manure is the missing load source in conservation plans. I don't know if a group got together and built it from the ground up and never cross referenced these. I think the conservation tillage is right and the name makes the most sense, but this list needs some polish. We need broad groups to make sure that the BMPs that we know and have verified on the ground are making their way to the model even if its not precisely the same crop.
Jess Rigelman: There is a typo on this slide, so what you said is correct. Roy + Hay is actually 13 load sources and agriculture is 14 load sources.
Elizabeth Hoffman (in chat): In response to the targeting comment earlier and the idea that the model is only giving us locked in acreages for land use - we target at the farm level based on resource concerns, and then attempt to get those BMPs credited in the model. That sometimes

results in cutoff, hence why we sometimes report at a higher level and allow it to be allocated into the smaller land uses based on the model, to get less cutoff.
Jess Rigelman: The larger load sources are also very important for all the more cumulative BMPs. Even if the land uses in the model and in the real world matched perfectly, it makes sense to use larger groups in the context of crop rotations and other cumulative management practices.

November Recap/Closing 10:45-11:00 [15 min (5 min presentation 10 min discussion) (Zach Easton, VT)]

Zach reviewed this month' progress for Crop Yields and Land Uses, as well as relevant information on how CAST addresses cover crops.

Adjourn – 11:00

Up Next: Friday, December 8th, 2023, from 09:00 - 11:00 am.

Participants

Jackie Pickford, CRC
Tom Butler, EPA-CBPO
Zach Easton, VT
Helen Golimowski, Devereux Consulting
Joseph Delesantro, ORISE
Olivia Devereux, Devereux Consulting
Steven Guinn, Chesapeake Conservancy
Geospatial Modeler
Tyler Trostle, PA DEP
Cassie Davis, NYS DEC
Alex Soroka, USGS
Tad Williams Virginia Tech
Curt Dell, USDA-ARS, University Park, PA
Scott Heidel, PA DEP
Dave Montali, Tetra Tech, WV, MWG
Eric Hughes, EPA-CBPO
Gary Shenk USGS-CBPO
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Ashley Hullinger, PADEP
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**Common Acronyms

AgWG- Agriculture Workgroup
AMT- Agricultural Modeling Team (Phase 7)
BMP- Best Management Practice
CAST- Chesapeake Assessment Scenario Tool (user interface for the CBP Watershed Model)
CBP- Chesapeake Bay Program
CBPO- Chesapeake Bay Program Office (houses EPA, federal partners, and various contractors and grantees working towards CBP goals)
CBW-Chesapeake Bay Watershed
CRC- Chesapeake Research Consortium
EPA- [United States] Environmental Protection Agency
TMDL- Total Maximum Daily Load
WQGIT- Water Quality Goal Implementation Team