Agricultural Modeling Team (AMT)
Meeting Minutes

March 8th, 2024
09:00 AM – 11:00 AM
Meeting Materials

Summary of Actions and Decisions

Decision: The AMT approved the February 2024 minutes.

Action: If you have additional feedback on annual yield estimates, please email Joseph Delesantro (jdelesantro@chesapeakebay.net).

Action: Email Tom Butler (butler.thomas01@epa.gov) with feedback on land use loading ratios by COB Friday, March 15th, focusing specifically on the discussion questions for a path forward.

Minutes

Statement of purpose:

To evaluate the crop yield and loading rates/ratios in CAST and discuss potential alternatives for Phase 7.

Introduction and Announcements: 09:00-09:15 [15 min (Zach Easton, Virginia Tech)]

Zach provided a quick recap of the AMT progress to date, as well as the groups' timeline and the following announcements:

- February 15th AgWG Remote Sensing discussions.
- Thank you, Jackie!

Crop Yield trends 09:15- 09:35 [20 min (5 min presentation 15 min discussion) (Joseph Delesantro, ORISE)]

We discussed progress being made to improve long term crop yields. This includes multiple potential approaches for estimating yields from the Five-Year Census of Agriculture using correlations to crops with existing annual yield data. Informational Update.

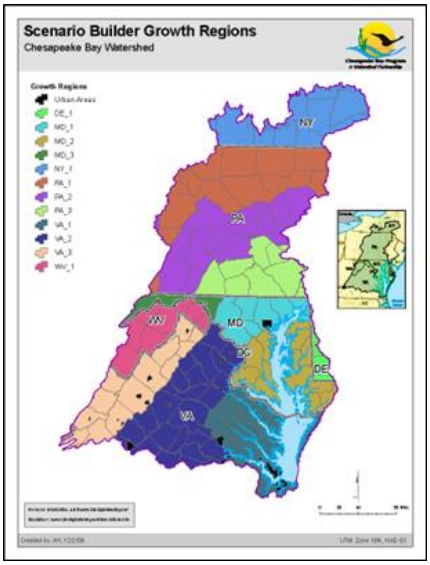
Discussion

Joseph asked for feedback about estimating yield trends in growth regions:

Dave Montali: I recall that WV has one growth region and I would think there might be different yields in highland counties with colder temperatures and higher elevations. I would guess there are differences but I'm not sure.

Mark Dubin: Yes, there are differences between counties within the same growth region. Precipitation and weather patterns can make a big difference between areas.

Tom Butler: Do growth regions vary between states?



Joseph Delesantro: Many states have several growth regions, NY and WV might be the exceptions. I was asking about the differences between counties within the growth regions.
Timothy Larson (in chat): What is the definition of "growth region"?
Olivia Devereux (in chat): Growth regions came from RUSLE and were actually determined with the expertise of Kelly Ireland Dubin.
Bill Keeling (in chat): Don't forget the differences in soils. Different counties have different distributions of soils that have different yield potentials.
Gary Shenk: So there are reasons why it would be different from county to county but those things (soils, precipitation, etc.) wouldn't necessarily change over time. Some of Joseph's concern was that some of these things may look different just because of luck. We're looking at hundreds of crops and hundreds of counties, so some of these might go down in yield if we have bad luck in sampling in some counties. The second question I think we are asking is if we can assume the trends within a growth region are the same? So can he have a base model that has different base values for every county, but constrain the trends to be the same?
Olivia Devereux (in chat): The growth regions were from the RUSLE crop management zones (CMZ) and then divided by state.
Ruth Cassilly (in chat): For more info- Growth Region model documentation is found in Section 3.1.3 - Terrestrial Inputs https://cast-content.chesapeakebay.net/documents/P6ModelDocumentation%2F3TerrestrialInputs.pdf
Mark Dubin: I would say the answer to the first question is yes. The second question about trends - I agree its luck of the draw with things like rainfall. The trends can probably be a way to buffer that a little bit because there will be variations.
Dave Montali: I would assume that the trends would be most sensitive to genetics. For that reason, I would say we should use the same trends across the growth region.
Mark Dubin: I would agree genetics and productivity are significant factors over the length of time you are looking at.

Joseph asked about annual yields for certain crops where estimates are hard to validate:
Dave Montali: Can we have just a flat trend? Is that what these datasets mean?
Joseph Delesantro: Yeah, that sounds like a valid option. Maybe some interpolation method.
Mark Dubin: There is a lot of variation in these trends based on crop production system. Wondering if applying a straight line trend would be suitable for some but not in others.
Joseph Delesantro: What do you mean by crop system?
Mark Dubin: This trend is showing rye and sorghum, but if you look at silage corn or soybeans, you might see a very different pattern.
Joseph Delesantro: Crops like corn and soy generally have well fit estimates that are specific to growth region and crop. I'm only talking about some minority crops that don't have clear yield trends. Are you saying that for rye we could use this estimate, but maybe we want to do something different for sorghum?
Mark Dubin: Yes. Maybe we need to treat different crops differently.

Dave Montali: My original comment was to be taken at the crop growth region scale. Not flat trends for everything.
Gary Shenk: What was helpful in the AMS when we were trying to determine soil P, it was a situation where we had a lot less data than this, but we had a method. So in this example, we would produce the crop growth region plots and have them available for folks to say whether or not they make sense, and that would help us get to a system of rules.
Joseph Delesantro: Okay, I can make these plots available.
Hunter Landis: You're not talking about the major crops right now, right?
Joseph Delesantro: Right. We're just talking about minority crops.

Joseph asked about estimates based on yields from neighboring regions with more data:
Mark Dubin: Could you use the data that you do have to match it up against neighboring crop management zones with the additional data that you were able to form a trend with? So essentially marry the two together.
Joseph Delesantro: Yeah, I could do that.
Ben Hushon: When we get adequate moisture we are seeing a pretty aggressive increase in yield on corn and soybeans. It's a slow partial bushel increase, but certainly the aggressive growers have been going up consistently in the last 10 years, more so in the last 5.

Action: If you have additional feedback on annual yield estimates, please email Joseph Delesantro (jdelesantro@chesapeakebay.net).

Loading Rates/Ratios in CAST 09:35-10:35 [60 min (20 min presentation 40 min discussion) (Gary Shenk, USGS; Mark Dubin, UMD)]

Gary and Mark reviewed how CAST works and how loading ratios work within its framework. They also reviewed what information was captured in previous efforts to create the current loading ratios. Informational.

Discussion
Lisa Duriancik-NRCS (in chat): Gary, for Phase 6, what were the crop type/management ratios based on? Same set of multiple model results?
Gary Shenk: Those were based on looking at Phase 5 CBP watershed model and 2009/10 Chesapeake CEAP model and SPARROW model. If you're asking about individual crops, that's what Mark will present on.
Lisa Duriancik: Mark, was there any effort to benchmark the ratios relative to any modeling results? Or just the monitoring data and publications?
Mark Dubin: The group was primarily looking at documented research values across the region. There was hesitation about using a model to create a value for another model. We would look at those values for reference, but they preferred looking at the actual data and documented values.
Lisa Duriancik: Theoretically, the monitoring data would be used at some point to develop algorithms for the models, and the models can capture more representative conditions. So models might be better able to integrate variability in estimates.
Bill Keeling (in chat): But they were fine using models for P and TSS.
Mark Dubin: We definitely looked at that. Gary brought in USGS information and we looked at other models like SPARROW. That is also why we decided to go with a ratio and not a specific value. We worked within the construct of the monitoring data.

Gary Shenk: That's a reasonable idea, Lisa, to see if the models return the same type of information that we're getting from the ratios. I don't know of any studies where that kind of granular land use specific information is available. We didn't have access to that information at the time.
Lisa Duriancik: Not sure if that's something we could get at this point. Maybe I can check with Candiss.
Mark Dubin: I would think that the ARS representatives on the Steering Committee would have had access to that, but not sure.
Tim Larson: In the 9 years since the literature was done, is there now high uncertainty in what we have? Do you think there is more data available now that we should consider?
Mark Dubin: Yes, I think there is more data available now. There's some information from a few studies that Ken Staver has done at University of Maryland Extension since then.
Bill Keeling: It seemed like everyone was okay with using a model to come up with TP and TSS, but not TN, so that's a bit inconsistent. I think we should be looking at modeled results. Also, in regard to Gary's presentation, the biggest arrow should probably be the overall "NPS" pie. There is error in the overall "NPS" value because we don't characterize the wastewater plants very well. Breaking down the total nonpoint further, there should be a higher degree of error. Also, I have a problem basing everything off leaching. Putting leaching as the benchmark for pasture has skewed it. I also think it's important to remember that scale matters. We were shown a Bay-wide scale that included BMPs. If you go to smaller scales and get rid of BMPs, you start to see significant changes in those loads. It's concerning that we are making decisions at a Bay-wide scale. Also, are we actually assigning the correct crops to the right aggregated group? Not sure if those classifications are correct. How are those assigned and aggregated?
Mark Dubin: To answer the pasture question - the initial recommendations from the Steering Committee were overcast with the decisions from the Partnership on the inputs and that was also reflected with some of the work done by expert panels. Pasture became its own reference point, not related back to corn with grain without manure. If you look in the report itself, there is an extensive discussion about pasture documented there. We had expertise on pasture within the group.
Bill Keeling: We ended up with pasture being based on the loadings on a survey done in MD, which represents a minority of the total pasture. That is basically setting up pasture in a nutrient management state, not a non-nutrient management state. I'm having a hard time with how things are classified and categorized. With multiple crops in speciality high, how is that one number derived?
Lisa Duriancik-NRCS (in chat): For P, there were some updates to APLE in 2022 also as part of our Legacy P Assessment. Version 3.0 is now available. https://www.ars.usda.gov/midwest-area/bowling-green-ky/food-animal-environmental-systems-research/people/carl-bolster/aple/
Jessica Rigelman (in chat): What crops were assigned to each land use was a decision the AMS made but it certainly can be revisited.
Gary Shenk: Good point, Bill, that we get more uncertainty as we reduce scale. If we were using the model to calculate the total load into a reservoir somewhere in the watershed, that's an application that we have to worry about, understand, and use local monitoring data; but its a different question if we are evaluating whether or not to do certain management actions in different places. The uncertainty between relative loading rates due to local inputs or leakiness of landscape is lower than the uncertainty of the overall load for a certain area or in the ordering of which BMPs are more effective in certain areas. Hard to quantify and systematize. We have to think about what decisions we are influencing on the ground and how much that uncertainty changes what is happening on the ground, which is another, larger discussion. Also, I

would like to understand specific recommendations that you might have about what we would change with pasture.
Jess Rigelman (in chat): crop to land use mapping can be found here - https://cast-reports.chesapeakebay.net/public/Detailed-SourceData-Crop.xlsx
Lisa Duriancik-NRCS (in chat): If nutrient application is considered separately (adjusted for using fertilizer sales data and assumptions about its use within a watershed), does adjusting for manure use in this ratio also double count use of manure? Is this ratio supposed to just represent inherent loss risk relative ratio by crop type?
Gary Shenk (in chat): Lisa, I don't think manure applications are double counted when using the ratios. The ratios are specifying that the difference is 40%. When we don't use the ratios, we estimate that the difference, based on mass balance, is a good bit smaller.
Tom Butler: We can definitely revisit what crop types are within what land uses - please reach out to me about what you guys might want to change. You make a good point about how different pasture behaves. Let's talk through some specifics offline.
Bill Keeling: It appears that loading rates for cropland have a lot to do with various presumed inputs in that one reference. Those are based on an expected yield, but we don't have an expected yield for pasture. I think if we're looking at yields for one form of grass - wheat or corn, e.g. - then we can look at yields for tall grass, orchard grass, etc. That should have some bearing on how those land uses are managed, rather than an assumption that they have no yield. Currently pasture has no yield related to its need and it should. Then we can figure out where it fits in the ratio of things.
Mark Dubin: A lot of effort went into pasture and that's discussed in the report. We talked about separating it into two different systems. We should use that information when discussing this in the future.

Discussing a Path Forward 10:35-10:55 [(20 min discussion) (Zach Easton, VT)]

The group was asked to provide feedback on how to move forward regarding the loading ratios and land uses currently in CAST.

Discussion
Dave Montali: Something that needs to be addressed - issue with livestock exclusion direct deposit. Too many animals are excluded from the creek.
Bill Keeling: Part of what you're seeing is that when grass and forest buffers are applied, some of them are applied to pasture and it's not just exclusion forest and grass buffers. So they are eating up some of the available acres for exclusion because of how they are applying other buffers. I'd argue that you can't have a regular grass or forest buffer on pasture unless you have fencing.
Dave Montali: I agree you can't have the other buffers, but when we do those things they get cut off in the model because of the amount of animals time in the riparian zone - the direct deposition of that BMP is being cut off.
Ben Hushon: Are we factoring in the source of commercial nitrogen yet? Or are they all treated equally? Because every year there is greater separation between sources of UAN versus ammonium sulfate, etc. and I thought the current model didn't account for source.
Tom Butler: We're talking about total N for this, but that fact might be relevant for manure and direct deposition conversation.
Jessica Rigelman (in chat): 17.6 AU per 1000 feet of fencing.

Dave Montali: I think it's resulting in too much exclusion and needs to be explored. Not today, but at some point we should look into that.
Alex Soroka (in chat): That's a good question Ben, we may need to get to better overall numbers for fertilizer application prior to considering different forms of N. Fertilizer application/sales data.
Bill Keeling (in chat): You can also report the number excluded instead of relying on a default
Elizabeth Hoffman (in chat): To the exclusion fencing conversation, I agree that we'd like to dig into it. In MD, we don't see cutoff but we also are actively verifying and reporting those through our NM regs and still not meeting that goal/target so we're wanting to understand that better as well from maybe the other angle.
Gary Shenk (in chat): Ben - That was a good point about the source of inorganic. Do you think there is good information on the relative runoff rates or uptake rates of these different sources?
Ben Hushon: I was actually looking at commercial fertilizer. There are so many different protections and codings now.
Gary Shenk: We have a hard time getting the inorganic fertilizer distributed to counties. If we can describe that and how it works differently in the environment then I think it would be great to put into the model. Also just want to raise the fact that the AMT can break out into small groups and propose changes and bring subjects up and present evidence if you feel so inclined. It doesn't always have to be presentations from the CBPO.

Action: Email Tom Butler (butler.thomas01@epa.gov) with feedback on land use loading ratios by COB Friday, March 15th, focusing specifically on the discussion questions for a path forward.

Recap/Closing 10:55-11:00 [5 min (Zach Easton, VT)]

Adjourn – 11:00

Up Next:

Office Hours: Friday, April 12th, 2024, from 8:00 - 9:00 am.

AMT Meeting: Friday, April 12th, 2024, from 09:00 - 11:00 am.

Participants

Jackie Pickford, CRC
Tom Butler, EPA-CBPO
Zach Easton, VT
Gary Shenk, EPA-CBPO
Joseph Delesantro, CBP ORISE Fellow
Arianna Johns, VADEQ
Ashely Hullinger, PA DEP
Alex Soroka, USGS
Ben Hushon, The Mill
Cassie Davis, NYSDEC
Clint Gill, DE
Curt Dell, USDA
Candiss Williams, USDA
Dave Montali, WV/MWG
Dylan Burgevin, MDE
Elizabeth Hoffman, MDA
Eric Hughes, EPA-CBPO
Helen Golimowski, Devereux Consulting
Hunter Landis, VA
Jess Rigelman, J7 Consulting
Jeff Sweeney, EPA-CBPO
Kate Bresaw, PA DEP
Kristen Bisom, WVCA
Lisa Duriancik, NRCS
Mark Dubin, UMD-CBPO
Nick Moody
Olivia Devereux, Devereux Consulting
Ruth Cassilly, UMD-CBPO
Scott Heidel, PA DEP
Tad Williams
Tim Larson, VADCR
Tyler Trostle, PADEP

Victor Clark, Farm Freezers
Bill Keeling, VADEQ
Pat Thompson, EnergyWorks

**Common Acronyms

AgWG- Agriculture Workgroup
AMT- Agricultural Modeling Team (Phase 7)
ARS - [United States Dept of Ag] Agricultural Research Service
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
CEAP - Conservation Effects Assessment Project
CRC- Chesapeake Research Consortium
EPA- [United States] Environmental Protection Agency
N - Nitrogen
NM - Nutrient Management
P - Phosphorus
PSC – Principals' Advisory Committee (CBP)
STAC- Scientific & Technical Advisory Committee
SPARROW - SPAtially Referenced Regression on Watershed model
TMDL- Total Maximum Daily Load
TN - Total Nitrogen
TP - Total Phosphorus
TSS - Total Suspended Sediment
UAN - Urea Ammonium Nitrate
USGS - United States Geological Survey
WQGIT- Water Quality Goal Implementation Team