Four ways to strip carbon out of agriculture and limit farming's climate impacts

Carbon is a "hot topic" in an age of Climate Change (pun intended). That is playing out in unique ways in the agricultural sector. On the negative side, fossil carbon emissions are driving the extreme climate events that are adding to the already significant economic risks of farming. But on the positive side plants have a carbon-related "super power." Photosynthesis allows them to use solar energy to pull carbon dioxide out of the atmosphere. That enables at least four carbon-related categories of value creation for the farm economy:

1. The normal Carbon Cycle (carbon that made your lunch…)

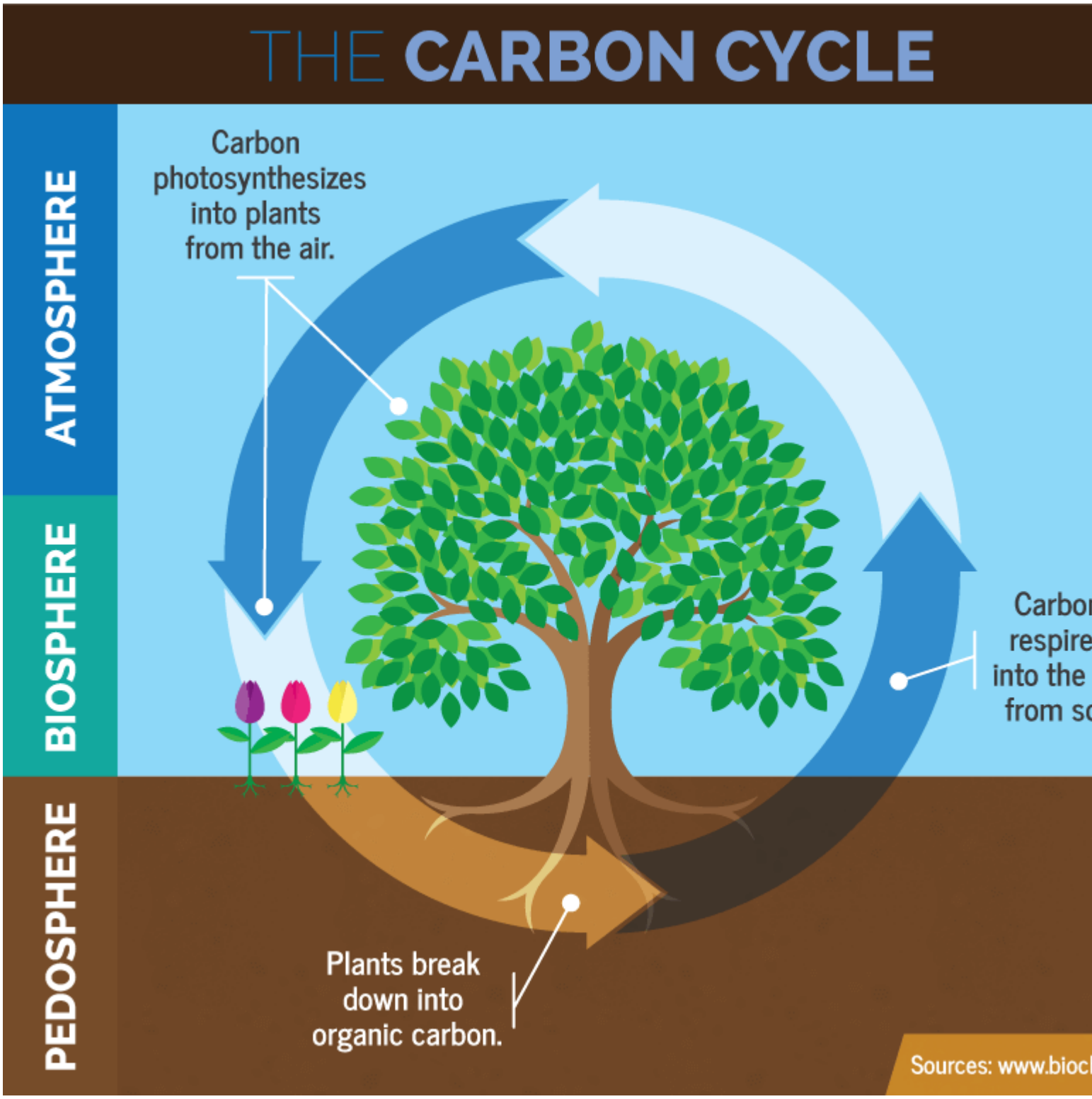
2. Carbon Substitution (carbon that made your container…), and

3. Carbon Sequestration (carbon that is taken out of the loop…)

4. Fuels with reduced "Carbon Intensity" (carbon that drove your car/truck…)

1) The Normal Carbon Cycle – carbon that made your lunch…

When the carbon captured and stored by crops in food or feed is metabolized, it is released back into the atmosphere as carbon dioxide. However, those CO_2 emissions are "carbon neutral" because they are just part of a circular process. That carbon and energy capture capability is the fundamental mode of value agricultural value creation. The World Bank estimates that this normal function of agriculture represents 4% of global Gross Domestic Product or GDP. Agriculture does have a "carbon footprint," but most of that comes from the production of nitrogen fertilizer, fuel use, and emissions of other greenhouse gases such as methane and nitrous oxide, and there are solutions in the works to reduce these sources. There are also several sustainable farming practices that are more climate friendly and farmers can be paid to implement some of those practices by participating in various initiatives funded by the USDA's Partnerships for Climate Smart Commodities grant program. Minimization of the farming carbon footprint also factors into the 4th mode of value creation described below.


THE CARBON CYCLE
ATMOSPHERE
BIOSPHERE
PEDOSPHERE
Carbon photosynthesizes into plants from the air.
Carbon respire into the from so
Plants break down into organic carbon.
Sources: www.biocl

2) Carbon Substitution – carbon that made your container….

Fossil-based plastics are the mainstay of the packaging industry. There is a growing segment of bio-based alternatives, and they can reduce the overall fossil carbon footprint for CPGs. These materials are often described as being "compostable." That may or may not actually occur depending on handling factors just as "recyclable" containers of all types might or might not end up being recycled.

3) Sequestration – carbon that is taken "out of the loop."

Some of the carbon dioxide that plants capture can end up in forms such as stable soil organic matter which doesn't get metabolized and re-released to the atmosphere. That carbon is "sequestered." This is a normal process that goes on in any forest, grassland, or other undisturbed natural setting to varying degrees, depending on soil type, land listory, land cover, and weather. This can also happen on cropland if certain soil health-improving farming methods are employed – specifically those that involve extremely limited soil disturbance (no-till or minimal strip-till…) and ways to maximize the time throughout the year with plants actively growing (e.g. adding cover crops, double cropping…). These practices are variously described as "continuous no-till," "regenerative" or "climate-smart," and in the medium to long term they create value through higher and more stable crop yields.

In the "Carbon Age" this kind of carbon capture can create value for agriculture through "carbon offset markets" which allow players in various non-ag sectors to offset their own greenhouse gas emissions by giving farmers a financial incentive to implement the practices that will enhance carbon storage in their soils. Particularly when it comes to No-till and Strip-till farming, there are farmers who have been doing this for years or even decades, so it has been somewhat frustrating that these innovators can't put their land in an offset program because a qualifying practice must be "additional." Those progressive farmers may still be able to qualify for carbon credits by adding cover cropping or other steps. The other issue for carbon credits is a requirement for "permanence" – a long-term commitment to continue tending the land in ways that will not end up releasing the stored carbon. That requires engagement by landowners for the large proportion of leased farmland.

There are some additional potential methods to increase long-term soil carbon on farms such as the application of "biochar" or the use of certain microbial inoculants (e.g. the CarbonNOW® program based the Rhizolizer microbial product from Locus Agriculture). There is also an approach called Enhanced Rock Weathering in which applications of specific kinds of agricultural lime can lead to carbon sequestration.

The largest player in the agricultural carbon offset market is Indigo Ag. They provide farmers with digital tools and information to assess the potential for sequestration/income in their field(s) based on thousands of data points collected and analyzed from both direct soil sampling and modeling. through using an initial soil sample and modeling (e.g. the DAYCENT-CR Model). The farmer has the option to join the program (or through it's "FieldFlex" program, farmers can choose to make money from their sustainable practices by participating in both the company's carbon credit and sustainable crop programs over time) and each year soil samples are taken from around 10% of new fields to assess baseline carbon stocks and provide

a starting point for the modeling of changes over time. The combination of satellite remote sensing data, management records from farmers, and advanced modeling is used to validate the practices and quantify the carbon impacts. Indigo recently completed its second harvest of carbon credits involving 427 farmers across 22 states that generated more than 111,000 metric tons of carbon dioxide equivalents – five times more than Indigo's first harvest in June 2022. It its two harvests combined the Carbon by Indigo program has sequestered more than 133,000 metric tons of carbon and paid almost $5 million to farmers. The company is on track to conclude its unprecedented third carbon harvest in early 2024.

4) Carbon Intensity – carbon that drove your car/truck.

One of the strategies to "decarbonize" the transportation sector is to power vehicles with biofuels, but the climate benefit of that approach depends on something called the "Carbon Intensity" of the specific fuel or fuel blend (the greenhouse gas emissions per unit of energy supplied). Ordinary gasoline has a carbon intensity score (CI) of 99 to 105. To incentivize biofuel optimization, there is a provision in the IRA (Inflation Reduction Act) which will pay a fuel company for each CI unit below a specific threshold of 50. A biofuel refinery can make some CI gains by optimizing their own fermentation process or adding CO_2 capture, but the main opportunity is to minimize the carbon intensity of the crops used to make the fuel. If a farmer uses "climate smart" or "regenerative" growing practices such as no-till and cover crops, that reduces the net greenhouse gas emissions per bushel in each growing season, and that can in turn decrease the carbon intensity of the fuel made from that crop. If enough of the growers supplying a given biofuel facility do that kind of farming, the resulting fuel qualifies for the "452 Tax Credit" and that income can be shared between the growers, the grain elevator and the biofuel company. There is an agronomy software company called Continuum Ag that has been at the forefront in this new category of carbon-related value creation. They help farmers tap into this source of value – as their website says to "Make Money with Soil Health." If a farmer is already growing their crop with carbon intensity reducing methods, Continuum helps them document this in order to qualify for a share of the value. They advise other farmers about how to implement the necessary changes to qualify for the payments. Indigo Ag, the carbon offset developer described above, has also started a similar program they call Indigo's Market+ Sustainable Crop, or "Source" Program that encourages farmers to track sustainable farming methods that can qualify the crop for a 452 tax credit. Indigo, Continuum and the broader network of trusted agronomic advisors can help farmers figure out how to optimize their potential income from carbon credit or carbon intensity opportunities.

Conclusion

So, although there are complications and limitations, "carbon age agriculture" is getting to play an active role in climate change mitigation. That role is expanding because of additional economic incentives for farmers to make important and often challenging changes in their farming practices. Fortunately, this can be a win/win since those methods are also beneficial in terms of the climate resilience of the lands so

farmed – an important component of climate adaptation.

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