Bill Lohry

One Answer To Global Warning: High-yield Agriculture

Increased crop yields could sequester more CO_2 to help mitigate emissions of fossil fuels while also supplying a hungry world with more food.

Summary: *Carbon dioxide in the atmosphere appears to be increasing. Carbon dioxide is considered to be one of the greenhouse gases that causes global warming. Total U.S. emissions from fossil fuels is about 5,300 million metric tons (mint). The administration wants to reduce emissions. It is a plan that could negatively affect our economy. Agriculture already assimilates tremendous quantities of CO_2, so an alternative option to emissions might be to increase sequestration of CO_2 by U.S. agriculture. To accomplish this, ag researchers should initiate more high-yield projects. Carbon sequestration would be increased to help mitigate fossilfuel emissions. More fbod would be produced, soil fertility enriched, and ag profits improved.*

In the mid 1950s I heard of a farmer who supposedly had a 100-hu/A corn field. Unbelievable, I thought. After all, the average U.S. yield in those days was 55 hu/A. When I pulled into his field, sure enough, stalks standing straight, plants a little over a foot apart in 40-inch rows, and a stand of probably 10,000 plants per acre. The soil was clear of weeds but hard—not a lot of corn leaves on the ground.

Fast-forwarding 30 years ahead I was standing in the field of another farmer I'd heard about: Herman Warsaw. I was

Table 1. Photosynthesis equation.

$6CO_2 + 12H_2O + \text{Light} + \text{Chlorophyll} \rightarrow C_6H_{12}O_6 + 60_2 + 6H_2O$

Actual example with a 9.2-billion bushel crop:

815 mmt CO_2 + water + light + chlorophyll ---> 555 mmt (carbohydrate) + 592 mmt O_2 (released in air)

Table 2. Facts about global carbon (as CO_2). Multilication factors approximate.

To convert tons of carbon to tons of CO_2 multiply by 3.67
To convert tons of CO_2 to tons of carbon multiply by .272

Amount of carbon (as CO_2) in various reservoirs	CO_2 (million metric tons)
Atmosphere CO_2	3,360,000
Biomass carbon (as CO_2)	1,760,000*
Fresh water	918,000*
Oceans, organic detritus, & soil organic matter	7,300,000 to 14,600,000**

*Bolin (1977)
** CAST (1992)

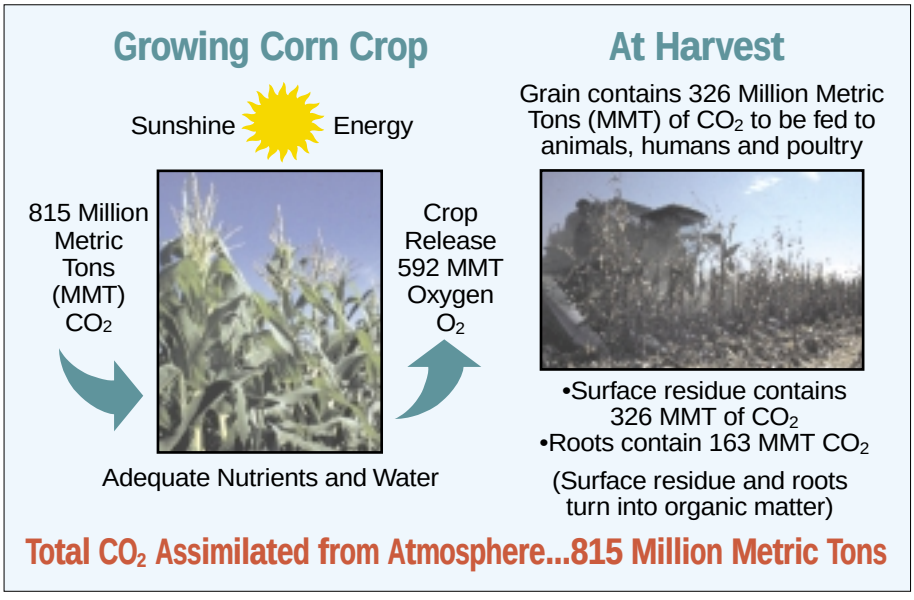

Figure 1. Anatomy of a 9.2 billion bushel corn crop.

looking at a corn field that would yield 377 bu/A! Warsaw's 10-year average was 275 hulA! Plants in narrow rows numbered 35,000 to 38,000. Leaves and residue littered the field. The soil was spongy because Warsaw meticulously built a deep fertile soil with a perfect balance of nutrients. After harvest, residue (almost 10 tons of stover) would be incorporated into the soil along with fertilizer to decompose organic matter. Warsaw's water-use efficiency (WUE) was over 11 bushels per inch of rain!

What does all this have to do with global warming? Plenty.

Corn absorbs large quantities of CO_2, (believed to cause global warming) in its life span of approximately 100 days. In 1992, 9.2 billion bushels absorbed 815 million metric tons of CO_2, (Figure 1)! Through the process of photosynthesis, sunlight energy plus chlorophyll from the green leaf transform CO_2, into carbohydrates (Table 1). In this reaction, CO_2, is absorbed from the air and converted to stover, grain, and roots. In 1992, CO_2 was "fixed" or changed into 493 million metric tons of stover, shell corn and roots! Stover and grain, rich in carbohydrates and protein, are harvested to feed animals and humans.

Let's see, more specifically, what this CO_2 absorption has to do with global warming.

Its many forms

It is believed by many that burning fossil fuels (petroleum, gas, coal, trees, etc.), is producing CO_2 that causes global warming. At the beginning of this century, atmosphere contained 290 parts per million (ppm) of CO_2. Now it contains 360 ppm, with the reasonable estimate it will go to 600 ppm. Some of this increase, but not all, is due to

Table 3. Total global emissions of carbon (as CO_2).

Natural emissions: (Volcanoes, vegetative decay, respiration of animals, humans, released from oceans, etc.)	550,000 mmt CO_2
Human activities (Fossil fuels, etc.)*	26,069 mmt CO_2
Total global CO_2 emissions	576,069 mmt CO_2
U.S. share of human activities:	
U.S. petroleum	2,279 mmt CO_2
U.S. coal	1,923 mmt CO_2
U.S. gas	1,167 mmt CO_2
Agricultural share of emissions:	
Energy	92 mmt CO_2
Fertilizer	40 mmt CO_2
Chemical	40 mmt CO_2
U.S. agricultural total	172 mmt CO_2
U.S agricultural share	3.2% of U.S.

*4.5% of total global emissions

Figure 4. Estimated carbon (stated mmt of CO_2) fixed by U.S. grain crop in 1996 and available for seqestering into organic matter.

Crop	Millions of metric tons of CO_2 Grain	Stover	Roots	Total	% of U.S. cropland (approximate)
Corn	326	326	163	815	22
Wheat	91	136	NE*	226	23
Soybeans	89	134	NE*	223	21
Sorghum	32	32	16	80	4
Other crops	332	NE*	NE*	332	30**

*Not estimated

** 19 other crops including hay, dry beans, potatoes, rice, sugarcane, beets, cotton, vegetables, and fruits.

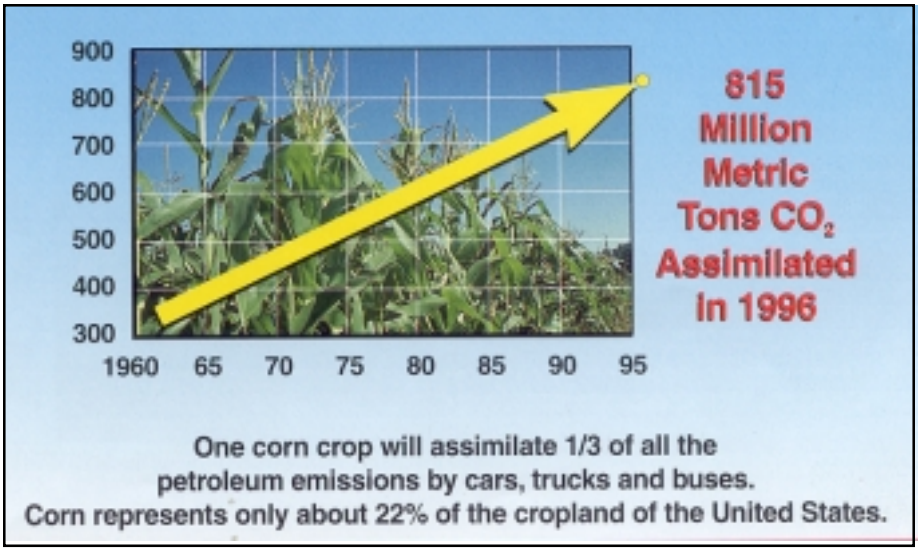

Figure 2. Growth in CO_2 assimilated by U.S. corn between 1960 and 1995 in million metric tons.

human activities.

benefit from such research.

Table 4 shows a current estimate of CO_2,of U.S. cropland. The 1,676 million-metric-ton/year estimate is probably low because many crops have not been studied to determine the amount of residue from roots and tops. All of these crops should respond positively to research to increase yields.

In addition to the 300+ million acres of cropland, there are about 700 million acres of forests. Some of these forest acres could be intensively managed to assimilate more tons of CO_2,. Fertilizing with the proper nutrients could increase new growth and fix more $C0_2$, as well as produce more desirable timber.

Finally, let's not overlook the 600 million acres of grassland.

A project to avoid the inanity of emission cutbacks would require a long-term goal— possibly 20 to 30 years. Remember, in the case of corn it took almost 40 years to come from 55 to 126 bu/A. I believe it is entirely feasible to set an average yield goal of 275 bu/A, matching Herman Warsaw's 10-year average. In 1997, Francis Childs, an Iowa corn farmer, averaged 280 bu/A!

Organic matter fragile

As seen, crops can absorb tremendous amounts of CO_2,. Carbon is fixed in harvested crops, and in residue/ roots left in fields. Fate of this carbon in harvested crops is difficult to quantify, but certainly much of it ends up as sewage or meat. The remainder is released as CO_2 by respiration.

Carbon in residue and roots is converted to organic matter under favorable conditions. Research is finding ways to increase the conversion percentage, primarily with new tillage methods and by adequate nutrition to aid microbial processes. New tillage methods also can prevent losses of organic mattdr once it is formed.

Stashing carbon is not a problem unique to agriculture. Forests are believed to absorb CO_2,and store it permanently. We know trees live, die, decay, and release CO_2,in the process. Long-term, food crops can store tremendous quantities of CO_2, in organic matter. However, it is true that after 20 years or so the soil will reach an equilibrium when no more carbon can be stored.

Environmentally beneficial

In conclusion, high-yield research could produce significant dividends that would substantially benefit the environment, the family dinner table, and, yes, even American agriculture. Projecting an average U.S. corn yield of 275 bu/A in the future would mean assimilation by the crop of 1,778 million metric tons of CO_2,!

Soil fertility would be improved! Soil erosion would be checked, as well as nutrient leaching by improving residue management!

More food would be available to meet the demands of an increasing global population!

Finally, higher yields would mean higher profits for agriculture!

Lohry is chairman of Nutra-Flo Company in Sioux City, IA.