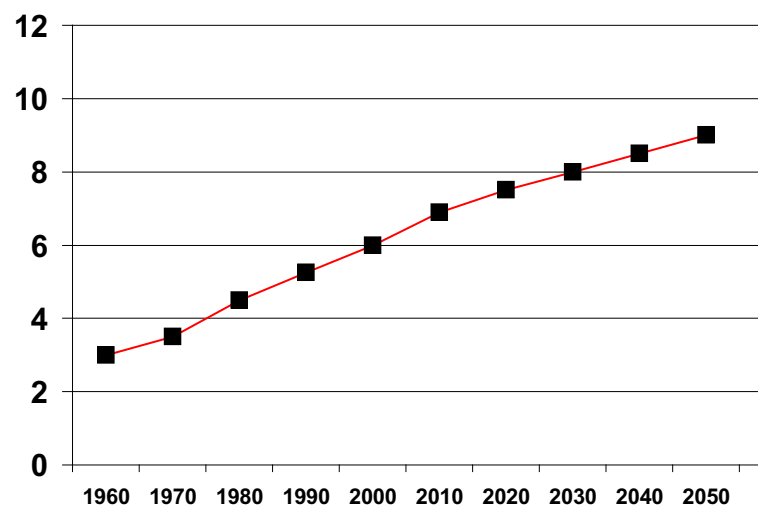


POULTRY AND SUSTAINABILITY

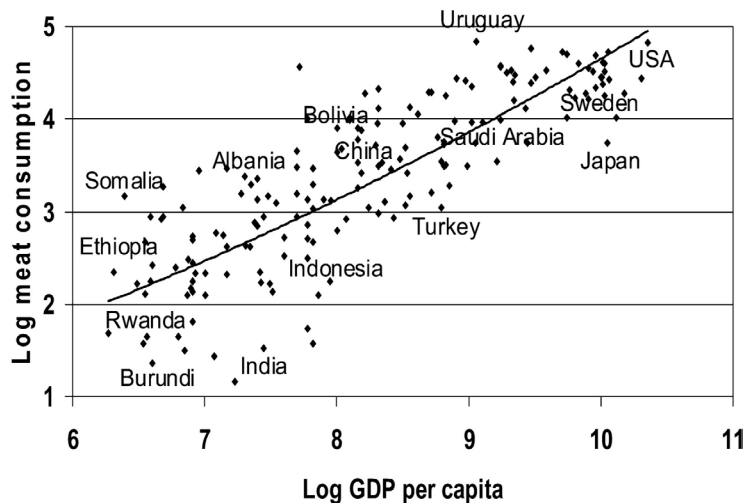
World farm output will roughly double in the next 40 years according to most predictions. Growth will be driven by a higher world population, increased disposable income and greater bio-fuel production. Missing from most predictions is a discussion about sustainability. Are current farm practices sustainable? If production is doubled is that sustainable? What are the practical consequences, if any, of being sustainable or unsustainable?

Although the rate of population increase globally is slowing down, total world population is nevertheless expected to increase by 2 billion people between 2010 and 2050 according to the United Nations.



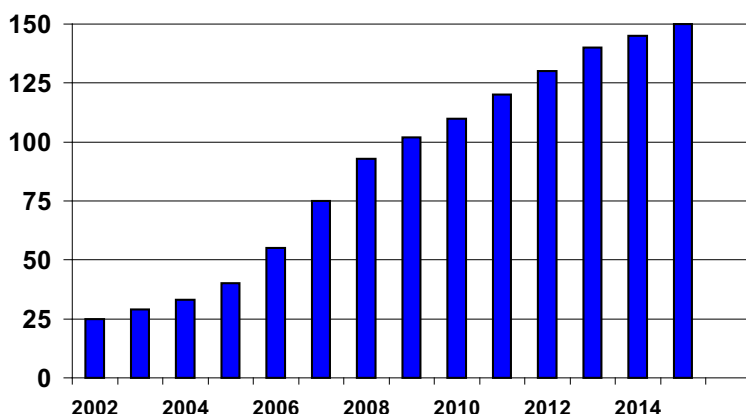
Rising income, particularly in developing countries where a sizable share of income is spent on food, increases the consumption of high quality animal proteins. There is a well known correlation between income and meat consumption shown on the following graph of meat consumption compared to GDP. As countries get wealthier over time they consume more meat.

Meat Consumption Compared to Gross Domestic Product



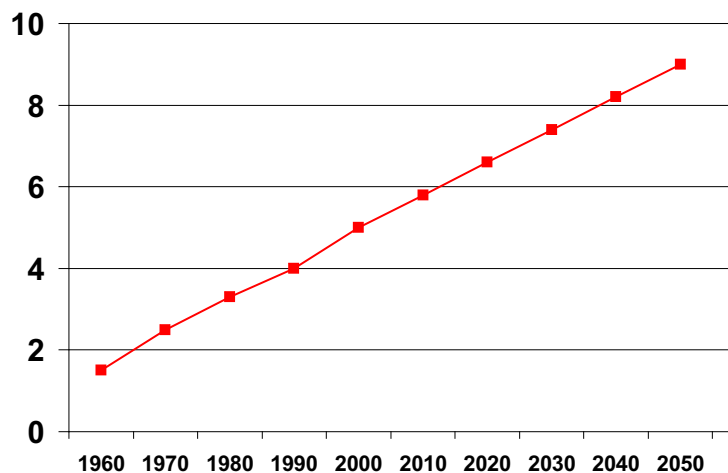
Not to be forgotten is the increased production of ethanol. From just 25 million metric tons in 2002, corn use for ethanol is expected to rise to 150 MMT in 2015. Use of corn for ethanol is likely to continue to expand in the future.

Ethanol Use of Corn in MMT - USA



Taking all of these drivers into account, a study published in Farm Policy Journal suggests that the overall farm output in 2050 will need to be 179% of the year 2000. The graph below puts that farm output number in terms of quadrillions of calories from corn, soybeans, wheat and rice. As can be seen, there has been a steady increase from 1960 to now and an increase of 79% to 2050 would be consistent with the recent rate of increase. By the way, one quadrillion is 1,000,000,000,000,000.

Quadrillions of Calories (Kcal) from Corn, Soybeans, Wheat and Rice

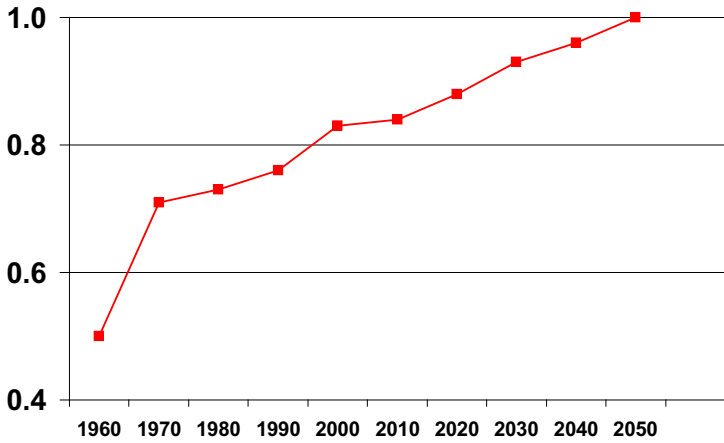


Higher grain production is of course vital to the animal protein industry but even more important is calories per capita. Without a steadily rising production of calories per person, increased production per capita of meat would be impossible. Falling per capita production of calories would result in the increased consumption of calories by people directly instead of sending those calories through farm animals.

Fortunately, calories per capita have been rising in the last few decades as can be seen in the graph below and are expected to continue to increase. By 2050 it is expected that one million calories per person per year from those four most important crops will be produced. Note the rapid increase in the 1960's when the

Green Revolution was in full flower. Since 1970, the increases have been smaller but none the less, they are increases. There is no technological reason why production per capita could not continue to increase in the future or even accelerate.

Millions of Calories (Kcal) of Corn, Soybeans, Wheat and Rice Per Capita



Are Increases Sustainable?

Over the last two centuries, there is always someone who suggests that the current trajectory of ever increasing agriculture production will reach a limit. One of the most famous was Thomas Malthus who warned in his 1798 book, "Essay on the Principle of Population" that people would soon run out of food. Others such as Lester Brown in the 20th century suggested in his book, "Who Will Feed China?", that the limit had been reached. So far, all of the dire food shortage predictions have been laughably incorrect and agricultural production continues to soar.

The grain shortage predictors have all been wrong about technology. They thought that limits to technology would someday restrict farm production while in reality; technology appears to have few if any limits. There is, however, another type of limit that could become worrisome, the physical limits of the earth's soil and water to sustain agricultural production. Although nobody knows for sure what those limits might be, and technology can expand the limits, there is nevertheless some ultimate physical limit to the carrying capacity of the planet. At some point, production could overshoot the ability of the earth to sustainably support farm production leading to a production crash.

Does sustainability matter? In the short term, no, it does not matter. However, in the long term the Stein law takes effect, which is "If something cannot go on forever, it will stop" sometimes rephrased as, "Trends that can't continue, won't".

What is the meaning of sustainable? Economist Herman Daly has suggested some simple rules or laws of sustainability:

- 1) For a renewable resource like soil, water, forests, or wild fish, the sustainable rate of use can be no greater than the rate of regeneration. For example, a fish harvest is unsustainable if fish are caught at a greater rate than the rate of growth of the remaining population.
- 2) For a non-renewable source like fossil fuel, the sustainable rate of use can be no greater than the rate at which an equivalent stream of renewable energy is developed. For example, an oil deposit would be used sustainably if an equivalent stream of renewable energy were developed to replace the declining production of the deposit.
- 3) For a pollutant the sustainable rate of emission can be no greater than the rate at which that pollutant can be recycled, absorbed or rendered harmless.

Are the laws of sustainability being respected or ignored? The evidence seems to suggest that they are mostly ignored. For example, although the amount of cultivated land has remained relatively constant worldwide for decades at around 1.5 billion hectares, there is a constant loss of land to urbanization, salinization, erosion and desertification. At the same time, new farmland is being brought into production. As a result, the total area of potentially arable land is shrinking while the total area of unproductive land is growing.

In 1950 there was 0.6 of a hectare of arable land per person in crops while today there is 0.2 of a hectare. Technology has made it possible to feed a growing population with less land per person thanks to the increase in yields. Nevertheless, the trends suggest a clear violation of the first law of sustainability; the sustainable rate of use can be no greater than the rate of regeneration.

Other examples of a violation of the first rule of sustainability can be found in the use of water. The Ogallala aquifer in the US, an aquifer that feeds 20% of the irrigated land in the US, is being overdrawn by 12 cubic kilometers per year. North China overdraws 30 cubic kilometers of water per year. In northern India, water tables are dropping by half a meter per year. Desert regions around the world are pumping water from aquifers that have little or no recharge.

In the area of non-renewable resources like oil the rate of use is far higher than the rate of substitution with renewable alternatives. Over the course of this year, 30 billion barrels oil will be consumed worth more than \$2 trillion dollars. The worldwide investment in renewable alternatives, although praiseworthy, comes nowhere close to a one-for-one substitution. The second law of sustainability is being mostly ignored.

The third law of sustainability is perhaps the one for which people are most respectful and one for which the greatest effort has been expended. However, despite massive efforts to clean up water and air, the amount of potable water is declining worldwide and air pollution is, once again, deteriorating after a period of impressive improvement.

If sustainability laws are mostly being ignored, what does this mean for animal protein production and in particular, poultry production?

Some Meats Are More Sustainable Than Others

In a world of willful ignorance of the rules of sustainability, one fine day the price of grain may begin to rise to much higher levels. This may happen 20 years from now, 40 years from now or 80 years from now but it will surely happen if the laws of sustainability are ignored. At that point, grain conversion will suddenly become overwhelmingly important. Luckily for poultry, the grain conversion of chicken, turkey and eggs are all significantly better than the major competition, beef and pork as can be seen in the following chart;

Comparing Beef, Pork and Poultry in the Production of One Kilo of Meat

BEEF	365 days 4 kg of grain 16,000 liters of water
PORK	180 days 3 kg of grain 6,000 liters of water
POULTRY	42 days 2 kg of grain 3,000 liters of water

To produce a kilo of feedlot beef requires a full year, 4 kilos of grain and 16,000 liters of water including all the water needed for growing the grain, growing the animals and processing the meat. Pork requires 3 kilos of grain, half a year and 6,000 liters of water. Poultry requires only 2 kilos of grain, 42 days and 3,000 liters of water. If grain and water become scarce in the future it will be poultry that will fair the best of the major meats and beef that will have most difficulty, and in particular, feedlot beef.

In the year 2050, two possible scenarios can be envisioned; first, a scenario of great grain abundance if sustainability is just another flawed idea like that of Thomas Malthus; and second, a scenario of grain shortage if violating the laws of sustainability has real consequences. Time will tell which is correct.

In the abundant scenario there will be at least one million calories of grain per year per person on the planet as is currently predicted by most experts. Thanks to abundant grain and increased income, meat consumption would increase significantly as shown on the chart nearby under the category of "Lots of Grain". Beef production increases by 50%, pork production by 65% and poultry production by 80%. Poultry increases faster than beef and pork due to its attractiveness to the emerging middle income populations of Latin America, Asia, Eastern Europe, Africa and the Middle East.

The other scenario (predicted by few experts) is shown under the column "Grain Shortage". Under this scenario, beef production 40 years from now is no higher than it is today while pork production is up by only 20% resulting in a significant reduction in per capita consumption for beef and a small loss in per capita consumption for pork as well. In stark contrast, poultry is projected to grow 40% and eggs, 60% in the grain shortage scenario.

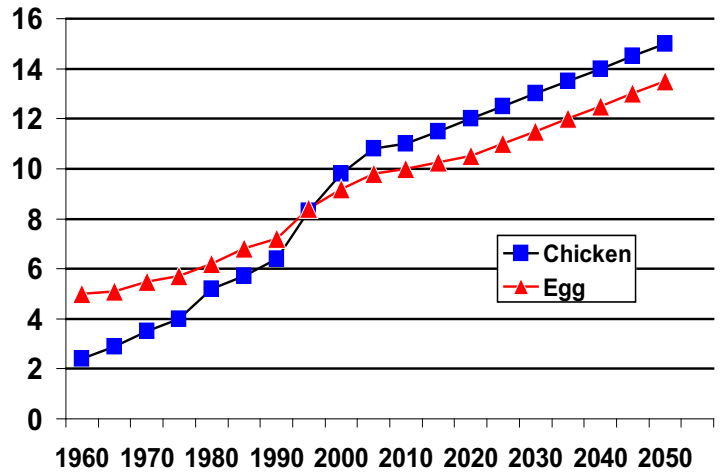
Poultry and eggs would grow robustly even in the face of grain shortages because of the fundamental advantage of better feed conversion. Poultry and eggs are highly sustainable animal proteins that do well in all conceivable future grain scenarios.

MMT of Meat and Eggs in 2010 and 2050

Meat	2010	2050 Lots of Grain	2050 Grain Shortage
Beef	56	84	56
Pork	101	166	121
Chicken	74	133	104
Turkey	5	9	7
Egg	68	122	108
TOTAL	304	514	396

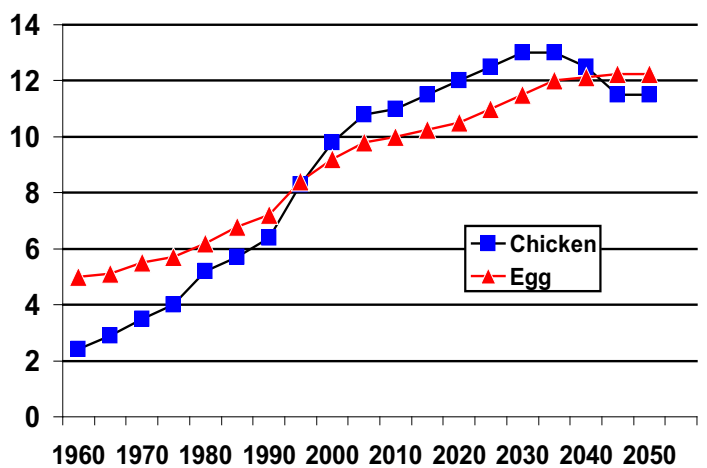
Under the abundant grain scenario world per capita chicken and egg consumption continue to increase robustly.

**World Chicken and Egg Per Capita Consumption
Lots of Grain - kg**



Under the Grain Shortage Scenario, the world per capita consumption of chicken would still be slightly higher in 2050 than it is today while egg consumption would still be significantly higher.

**World Chicken and Egg Per Capita Consumption
Grain Shortage - kg**



Which scenario is more likely? History and expert predictions favor abundant grain. However, while being ready to take advantage of the first scenario, it would be prudent to be prepared to adapt, if necessary, to the second, less attractive scenario.

About the Author - Paul W. Aho, Ph.D.
e-mail: PaulAho@PaulAho.com

Dr. Paul Aho is an international agribusiness economist specializing in projects related to the poultry industry and has been a prolific writer in trade journals in both the United States and in Latin America. Dr. Aho now operates his own consulting company called "Poultry Perspective". In this role he works around the world with poultry managers and government policy makers.