The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

How the Energy Crisis Will Help My Diet

Posted by Prof. Goose on July 18, 2006 - 10:47am
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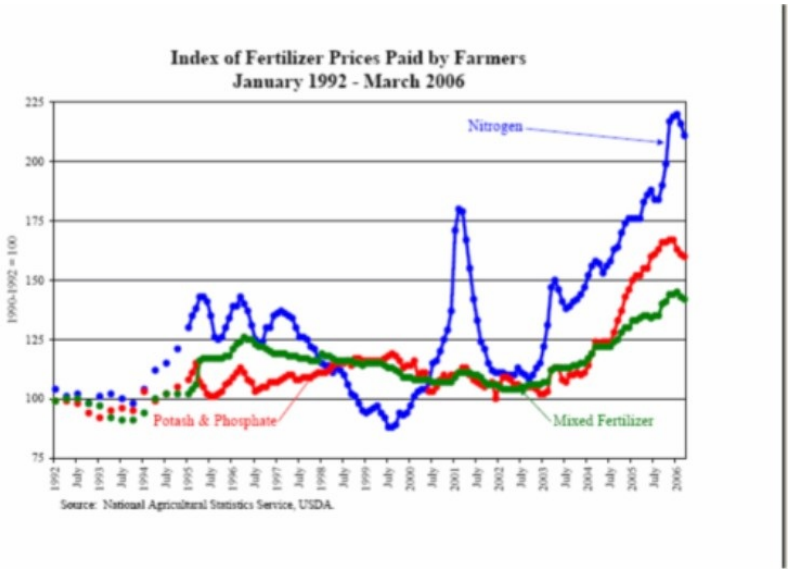
[editor's note, by Prof. Goose] This is a guest post from seismobob.

Like many Americans I am a bit overweight and this is true even after living a year in China eating indigenous food and shedding 15% of my body mass. Coming back to the fattest city in the land of the big helping, I am concerned about regaining that weight given the fact that Americans eat 920 kg of food annually (3,800 kcal per person per day). But never fear, the energy crisis will eventually help me maintain my desired weight. Many are going to wonder what does the energy crisis have to do with being fat. Well, the modern agricultural system is nothing but a system which turns petroleum and natural gas into food. Thirteen kilocalories of energy is used to produce each kilocalorie of food we eat (p. 20).

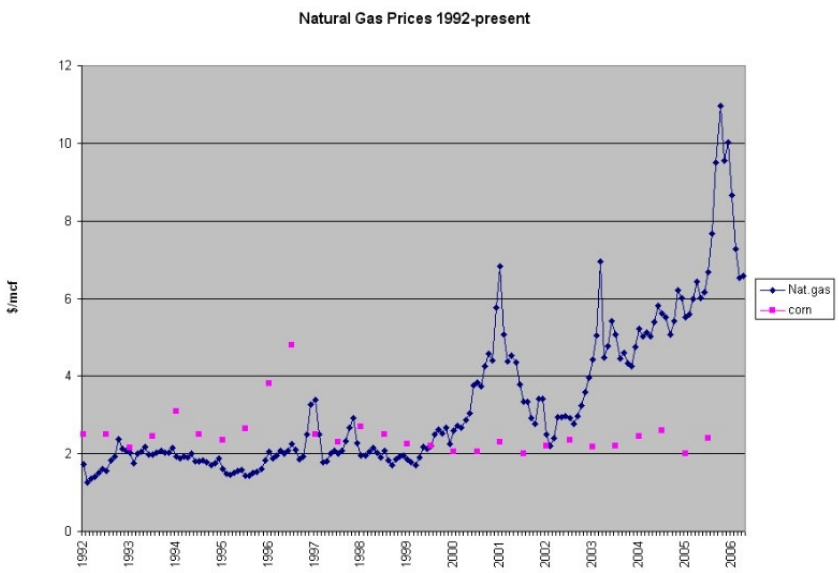
When energy becomes scarce, the quantity of food will decline.

The first place to look at this is in fertilizer. Nitrogen fertilizers are made using lots of energy. In the US it is natural gas which is used but in China it is coal. The manufacture of nitrogen fertilizer uses 1% of the world's energy supply. And this one percent feeds us. There is a direct correlation between fertilizer price and natural gas price in the US.



Here is the natural gas price on the same time period (blue curve) with the pink dots being the corn price per bushel. The thing to note here is that the corn price is not following the natural gas curve, so when the natural gas price rises and the corresponding increase in price of fertilizer

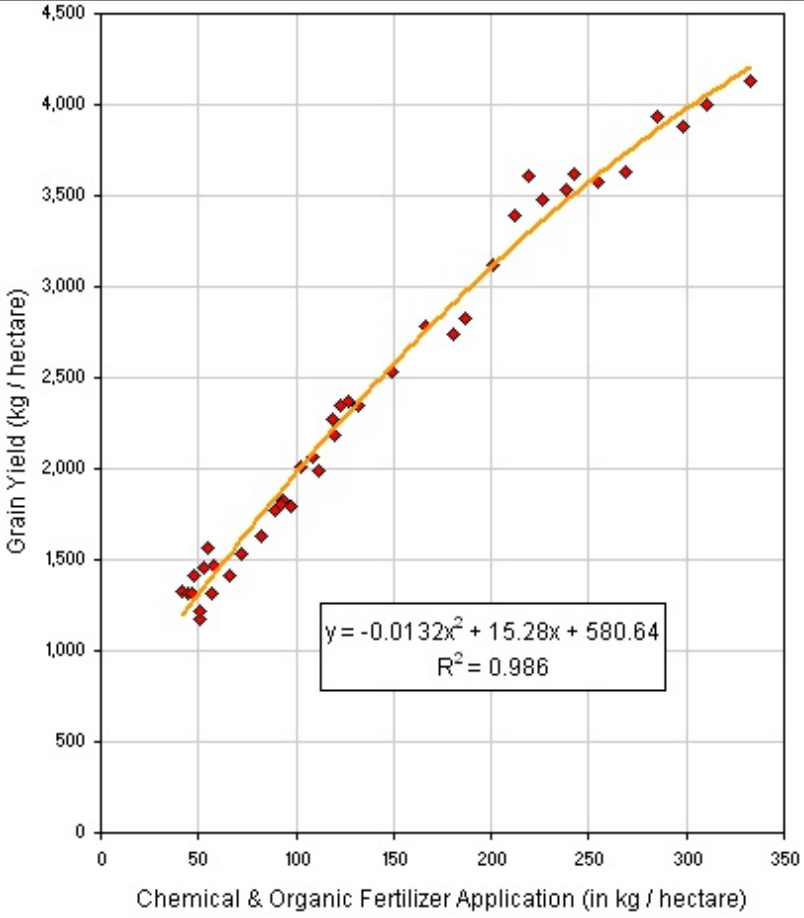
occurs, the farmer must make a choice as to how to balance the budget. The decision often includes using less fertilizer to cut costs.



At $5.00 per mmbtu ammonia costs $200 per ton, but at $19 per mmbtu, the price rises to $650 per ton. Clearly one can see that as energy prices rise, fertilizer prices will rise followed by two things, a rise in the price of food and a reduction in the use of fertilizer as farmers try to cut costs. Farming has narrow margins. Is there any evidence of a drop in usage of fertilizer? Yes. Since natural gas prices began rising in 2000-2001, sixteen fertilizer factories have been shut permanently and five more suspended operations. There was a slight dip in reported fertilizer use during the 2001 spike in fertilizer price. Corn went from 136 lb per acre to 133 with a 2% drop in treated acres. With soybeans the pounds per acre remained the same but there was a 7% drop in treated acres and with cotton there was a 7% drop in treated acres and a 7 lb/acre reduction in usage. Here is the historical use of nitrogen fertilizer use on corn in 1000 nutrient tons. Note the dip in use in 2001 when the gas price spiked:

1992--4,887
1993--4,369
1994--4,954
1995--4,492
1996--5,181
1997--5,118
1998--5,226
1999--5,043
2000--5,301
2001--4,625
2002--5,188
2003--5,140

By the end of this century there will be no commercial quantities of oil, natural gas and coal with which to make fertilizer. So, what is the effect of a lessening of fertilizer use? Lower crop yields. Below is a chart of crop yields vs. fertilizer application in China. There is a direct correlation between fertilizer and crop yield.



(from Wang, Q. et al, 1995)

Smith et al.(1990) studied the impact of fertilizer on crop yields. They concluded that over a 71 year period fertilizer was responsible for 40% of the wheat crop; over a 45 year period fertilizer was responsible for 57 percent of the corn yield.

So, one can easily understand what will happen if fertilizer use drops. There is a modern example of the impact; it is seen in the starvation which is taking place in North Korea. They underwent a power shortage. which affected lighting, industrial production and agriculture. The effect was a precipitous drop in fertilizer production with the resultant drop in crop yields followed by starvation. One of the chief aid requests from the North Koreans is fertilizer. picture here.

Is there an organic way to avoid this problem? Some authors are writing that we can use animal manure to fertilize the farm fields. A paper (Pimental et al 2005) last year in Bioscience took such an approach and concluded that animal manure could replace fertilizer with no loss of productivity. They used 5.6 metric tons two years out of five, so that averages out to 2.24 tons per year. So, how many cows are needed?

A dairy cow can produce 120 pounds of fresh manure per day. But that has a water content of 88% meaning one cow can produce about 1.8 tons of dry manure per year. Thus it takes more than one cow to produce the fertilizer Pimental et al require. Other rules of thumb I have found say that one cow can fertilize 1.5 acres. But if, without fertilizer, it takes 10 acres to run a cow, then that cow can not provide enough for self-fertilization of his own fields, much less for other fields.

And there is another issue, something forgotten by Americans because this knowledge is from the

lives of our great-grand parents. If one does not have energy to the point of needing heat, then cow manure won't be available for fertilization. It will be burned for cooking and heating purposes. Two months ago, I went to Tibet on business. I visited a farm and went to areas where nomads live. I saw manure-as-fuel in action. On the farm they mixed yak dung with straw, patted it into potato-sized balls and then stored it on the exterior walls of their houses (what a fun job that must be). This helps insulate the house but is also a convenient way to grab some fuel quickly.

But this use of manure means that it won't be available for fertilizer if by the end of this century we have no other source of energy.

We now examine whether ethanol can fuel the required fertilizer. Using 2.5 gallons per bushel for the ethanol and the record corn crop of 136 bushels per acre we find that an acre produces 340 gallons. The US uses 146 billion gallons per year of gasoline today, but because ethanol has only 70% of the energy content of gasoline we would require 1.4 times more or 2.08 billion gallons of ethanol to maintain our lifestyle.

How many acres will this require? Well, today the US uses 491 million acres under cultivation and my math says we need 691 million acres to manufacture enough ethanol to manufacture both the fertilizer and enough other ethanol to fuel transportation. The US has on 945 million acres devoted to agriculture. Clearly there is a problem. Without the fertilizer the US would need 3.6 billion acres of corn to make the ethanol, clearly an impossibility. Another way to look at it is if we and the cows all stop eating corn and use the present corn acreage (80 million acres) all for ethanol, we could produce 27 billion gallons per year, or about 13 percent of what is needed for transportation and fertilizer combined.

To close, a reduction in the available energy will help our weight loss. As one Pfeiffer observed, to achieve a sustainable US, we must reduce our population by around one third. I think he is an optimist.

References

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