Does Less Energy Mean More Farmers ?

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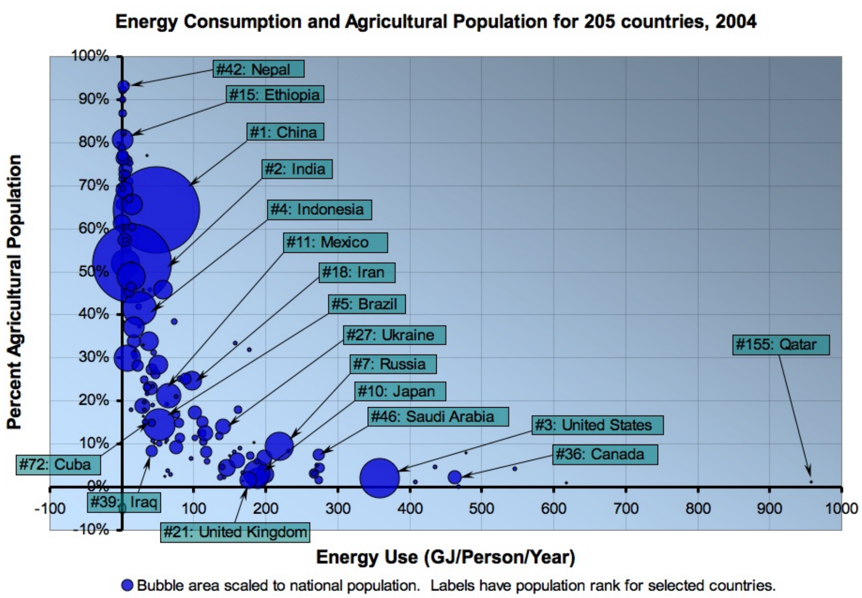
This is a guest post on energy and our agricultural system, by Jason Bradford, who has written here previously on "Relocalization: A Strategic Response to Peak Oil and Climate Change". Jason has a Phd in Biology and has written/published on the topics of relocalization and ecological economics. He is the founder of Willits Economic Localization (WELL) and runs a CSA in Willits, CA. (He also has a biweekly radio show "The Reality Report", where next Monday at noon EST he and I will be discussing evolution, addiction and economics. His show can be heard streaming online at www.kzyx.org.)



DOES LESS ENERGY MEAN MORE FARMERS?

Among the cadre of folks who think about food systems and sustainability in the U.S., there's a concern about the number of farmers and their age. Only about two percent (5,802,000/295,410,000 in 2004) of the U.S. population is part of a farm family, and the average age of principal owners of farms is about 60 years. Since mechanization and the fuels that power machines are what enable such a small agricultural labor force, is it reasonable to assume that a decline in fossil fuels will require more farmers?

Others, such as peak oil educators Richard Heinberg and Sharon Astyk, have suggested this will indeed be the case, even going so far as to put a rough number on the future farmers of America. Their estimates are based on looking at the proportion of farmers in an early to pre-industrial economic system in the United States, when about a third of the population engaged in agriculture. They then adjust for current population size to arrive at the admittedly tentative figure of 50 to 100 million farmers (or members of farming families) needed to feed a population of 300 million.

As these authors point out, not only is the absolute number very large compared to today, but given the age of the current crop of farmers it implies that a rapid education of youth will be required to keep bread on the table. Given the importance of this topic, I feel that more diverse and sophisticated forms of analyses are needed. Just as we use multiple lines of evidence to understand the evolution of life, oil depletion, and climate change, we need to look for confirmation from many angles. Furthermore, better knowledge potentially gets us closer to grasping the scale and rate of change required to cope with the problem in the same way that depletion rates in existing fields and net exports analyses do in the oil situation, or the timing and consequences of melting ice sheets and release of methane from warming permafrost do in the climate system.

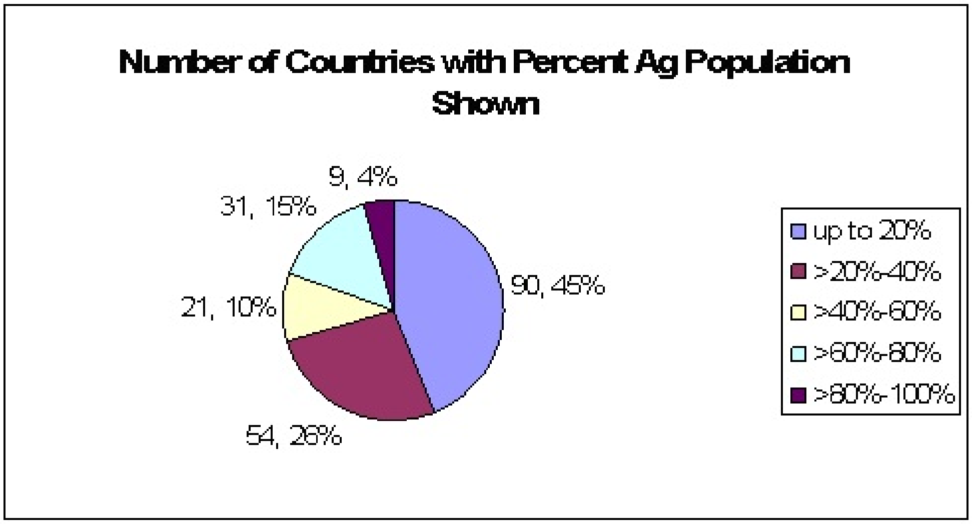
Perhaps we can validate or refute this scenario by further use of the comparative method. The comparative method is what Heinberg and Astyx used in their analyses—comparing a future scenario to a potentially analogous historic past. In the analysis presented here, I take as a given that the United States (and other high energy consuming industrial countries) will have less energy available in the future, at least of the type currently used in mechanized agriculture. The comparison I use is not historic, but contemporary. I know that today some nations have much less energy consumption than others and anecdotally I am aware that poorer countries tend to be more agrarian. If nations with less energy consumption have more farmers, it would support the notion that a reduction in energy consumption in the U.S. (and other industrialized countries) will lead to an increase in farmers.

Is there a discernable inverse relationship between energy consumption and agricultural populations among nations?

Let's take a look. First, I had to find total population by nation and agricultural population (which I believe means farmers and their immediate dependents) by nation. These data can be downloaded from the United Nations Food and Agriculture Organization (FAO) (http://faostat.fao.org/site/550/default.aspx).

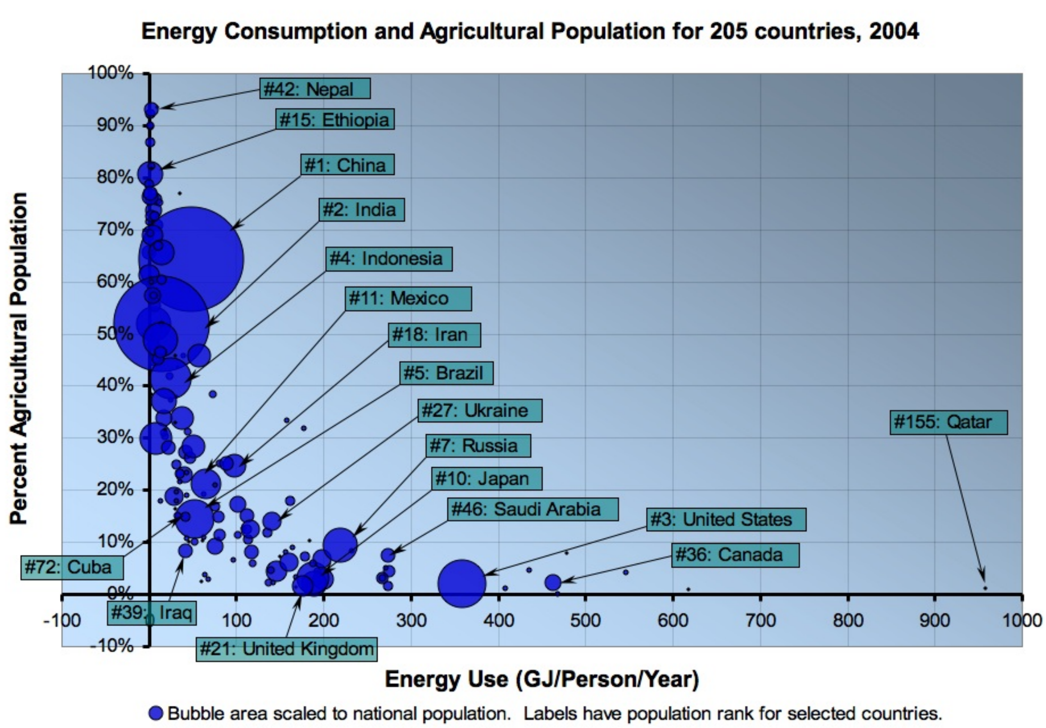
Simply dividing the agricultural population by the total population gives the percentage that live an agricultural life. The range of this figure is huge, from essentially zero for places like Singapore to over 90% for places like Bhutan. I really don't know how accurate censuses data are from the 205 countries used (not all places are fully independent nations, e.g., Puerto Rico is separated from the U.S. in these data sets), but assume figures are in the ballpark. Certainly citizens of Bhutan and Singapore have vastly different livelihoods. According to 2004 FAO data, overall about 41% of the world's people still live in families who work in agriculture (2.6 billion out of 6.4 billion).

Most nations (about 70%) have 40% or less of their population in agriculture. This means that the fewer countries with high percentages of agricultural workers have large populations, e.g., China and India are 64% and 52% respectively and equal about a third of the total world population. In all likelihood, large populations correlate with high population density. As a 1997 paper by Conforti and Giampietro showed, economic forces in poorer nations with dense populations tend to retain farmers.



Second, I had to find energy consumption data. It is difficult to locate data on use of wood, animal dung, etc., but for commercial energy such as oil, natural gas, coal, and electricity the Energy Information Administration (EIA) of the U.S. Department of Energy has available spreadsheets for download (see table E.1 at http://www.eia.doe.gov/iea/wecbtu.html) . While this doesn't include all forms of energy, it does cover the forms most readily usable in an industrial agricultural system.

I had to do some work to harmonize the two data sets, which meant using 2004 data and limiting the analysis to 205 nations—which I figure is fairly complete. The figure below shows the results, plotting the percent agricultural population as a potential response to per capita energy consumption. (Note: A big thanks to Stuart Staniford for constructing the bubble plot).



Click to enlarge.

As expected, nations with relatively little commercial energy consumption tend to have lots of farmers. The relationship doesn't appear linear (perhaps putting energy on a log scale would change that, the X axis ranges from 0-1000 and the Y axis from 0-100), and is not very tight. I see some evidence that tropical nations can get by with less energy than temperate zone nations and still have similar proportions of farmers (e.g., compare Cuba to Ukraine and Mexico to Iran). This result could be explained by heating and cooling demands in temperate countries and/or higher crop productivity due to soils or climate factors.

While these results are supportive of the general hypothesis, I find it difficult to use this method and these data alone to get at the scale and rate of change questions. What might it mean, for example, for the U.S. to be using ¾ less energy by 2050? Many places today are already using that much less energy and have just as small of an agricultural population as the U.S., but surveying the spreadsheet it appears that many could be considered special cases, such as small islands swarming with tourists or tax havens for the wealthy, which can simply afford to purchase most of their food. Other large nations with ¼ of the energy use of the U.S. have between 10-20% of their population in agriculture. Considering that such a range is 5-10 times the current percentage does stagger my mind a bit.

Other questions that arise include: Whether U.S. farming can remain as energy intensive as it is today by taking a larger share of resources from other sectors of the economy? Because no modern economy can survive without them, I would expect extraction and production sectors, such as mining, agriculture and manufacturing to decline at a slower rate than, for example, finance, tourism, and real estate. Are dramatic efficiency gains still to be had in conventional U.S. agriculture, or has the farm sector already been through enough energy and financial dramas to have played out the easy options?

As in any good subject for research, answering one simple question provokes a series of more difficult ones.

Though I may have just done so, I am mistrustful of studying this issue in isolation. Nagging at me is the question of whether the globalized industrial system is inherently unstable in the face of multiple challenges, including energy scarcity but also the converging crises spawned by the surging weight of humanity. Climate change, financial wobbles, violent conflicts and related spin-offs can unpredictably disrupt the vast system of trade that moves fertilizers, seeds and replacement parts that keep industrial agriculture humming. I think we are already seeing hints of this scenario in the U.S., as farmers run short of diesel fuel during harvest season and end up leaving crops in the ground.

Conclusions

While I would appreciate more work towards the questions posed here (and contact me if you have ideas and skills to help), I also caution against analysis paralysis. There are multiple reasons why agriculture needs to undergo a profound shift and spending too much time trying to circumscribe the problem may delay us moving towards appropriate responses. I believe the broad vision of what needs to be done already exists—food that is more local, organic, produced, processed and distributed by renewable energy systems, and using cultivation methods that put the soil health first. Making that argument to those who are reluctant or suspicious, however, could use some better research that connects the dots credibly between energy depletion, climate change, food security, and demographics.

**Acknowledgement: *Thanks to Stuart Staniford for both the bubble graphic and checking for accuracy of spreadsheet data manipulations.*

References:

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