

# ESA21

Environmental Science Activities for the 21st Century

## Food Calories and Land

### Introduction

If you check any popular newspaper, magazine, or television news show in the last year or two, you have heard this same story countless times: Americans are fat, and getting fatter. Every year, new studies reported that show that the situation is getting worse. By 2002, the National Center for Health Statistics found that 65% of all adult Americans were overweight. This figure is significantly higher than the 47% of adults who fell into this category just 20 years before in 1980. To make matters worse, 31% of adults were more than 30 pounds overweight, moving them into the obese category. This is more than double what it was in 1980, when only 15% of adults were considered obese.<sup>1</sup>

It is doubtful that this situation is going to change anytime soon. In the same study, the NCHS found that 16% of children aged 6-11 were overweight. This is a fourfold increase over the percentage in 1960, when only 4% were overweight.<sup>2</sup> The interesting thing is that the majority of this increase has occurred over the last 20 years, just as it has for adults. In 1980, only 7% of children were considered overweight.

What does this data mean? It means that we should expect to see coronary disease increase, as more people experience clogged arteries. It also means that we should continue to see a rise in many other types of diseases that are linked to obesity, such as Type II diabetes. This, of course, means that there will be a serious impact on the economy, as there will be higher insurance rates to cover medical bills and more loss-time on company payrolls as people fall ill. But, not so obviously, it also means that there might be a serious impact on the environment. To understand why, let us look at the average diet of Americans.

### Diet

One reason for the increased rates of obesity is an increasing lack of exercise. We lead a more sedentary life today than we did 30 or 50 years ago. This is due to many factors, from suburbs designed to reinforce transportation by car to our increased use of computers and television. But another reason for our increase in obesity is that our diet has changed significantly over the same time period. It is not just that we eat more, but that we eat different foods in a different manner. The different foods that we eat are processed by our bodies differently, resulting in greater weight gain.

Fifty years ago, food consumption in the U.S. was at its lowest point for the century. At that time, the average American was consuming about 2,000 calories a day. Less than twenty years later (1970), this figure had increased modestly to about 2,200 calories per day, which is about the what the USDA recommends as an average for the total population<sup>4</sup>. However, we have greatly expanded our consumption passed this recommended point. The average American today consumes just under 2,700 calories per day. This is more than what is recommended healthy active males in their early 20's, which

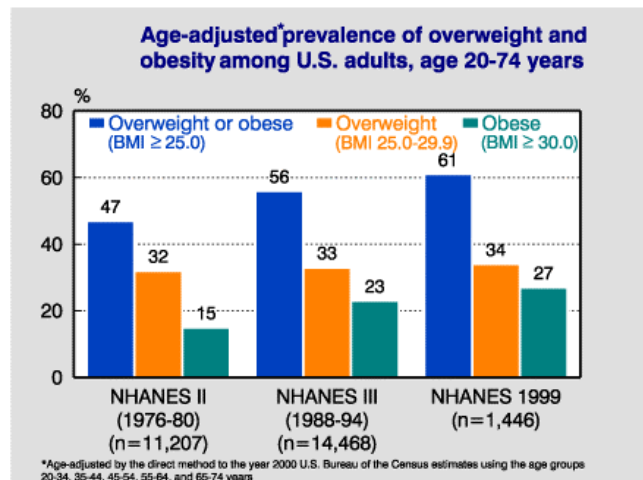


Fig. 1: U.S. adult obesity rates (*Dept. of HHS*)

constitute the group with the highest caloric intake. When one considers that this figure also includes children and inactive adults, it is easy to see why our obesity rate is what it is.

Looking at just calories, though, does not tell the whole story. During the same time span that our caloric intake has increased, the types of foods that we have been eating has also changed. Over one third of the increase in calories from 1970 to 2000 was accounted for by an increase in grain consumption. Most of this was in the form of refined grain products, such as white bread and pastries. An equally large share of the increase was due to added fats and oils, like that found in fried foods and white bread. Besides these two categories, the remainder of the increase in calories was due mostly to added sugars (about 20% of the increase).

Together, these three things help to explain some of the increase in obesity. Refined grain products are quickly broken down by the body, causing an almost immediate increase in blood glucose levels like that of added sugars. If this extra sugar is not used immediately, it gets stored as fat. At the same time, the spike in blood glucose levels is usually followed by an increase in insulin to handle the huge load. Once the spike has been processed, blood glucose levels usually fall below their normal levels, causing feelings of sluggishness and lethargy in the body. This leads to a lack of exercise, which exacerbates the situation. The addition of the fats and oils on top of this just causes the system to go even further in the direction of adding weight.

These were not the only large changes in our diet. In the 1950's, the average American consumed 138 pounds of meat. The majority of this (107 pounds) was in the form of red meat from cattle and pigs. Since that time, we have increased our meat consumption to 195 pounds per person. While our red meat consumption only increased by 7 pounds during that time, we added an additional 46 pounds of poultry to our diet. Such a large increase should have resulted in a large caloric increase. However, concern about fat in our diet during this period led to leaner animals and cuts of meat, which actually resulted in a lowering of the amount of fat in our diet from meat.

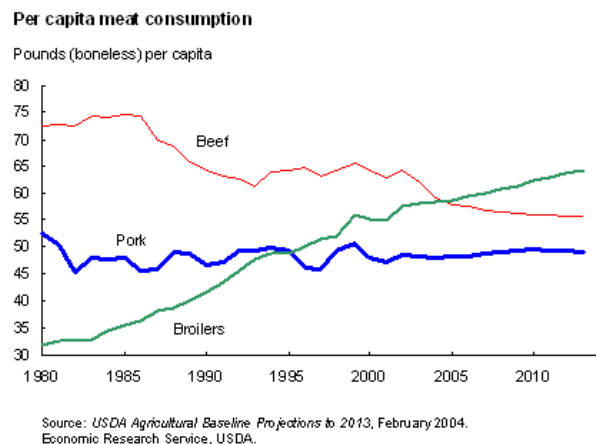


Fig 2: Meat Consumption, 1980-2010

## Environment

These increases in consumption have had more than just an impact on our waistlines; they have also had an impact on the environment. The mere fact that more food is being consumed means that more product has to be transported to market, resulting in higher fuel usage. More oil and natural gas are also needed to create the artificial fertilizers used to grow the crops, and more energy is needed to plant, and harvest the crops. Both plants and animals require water, which means that the increased foodstocks correspond to increased water usage. And while there has been a "Green Revolution" over the past 50 years that has allowed for greater crop production on each acre of land, these increases in per capita consumption have resulted in a net increase in the per capita land usage. This would mean that, even if our population was not increasing, we would need more land to be converted to farmland as our caloric consumption increases.


This increased land usage is especially true in the case of meat and animal product consumption. In general, the amount of meat that can be raised on a piece of land is about one-tenth that of the amount of plant matter that can be grown on the same land. Since meat is about twice as dense in calories as plant material, this means that the number of calories per acre of land is about 5 times more for grain and vegetables than for meat. On average, an acre of land can grow about 1,200 per day of meat or about 6,000 calories per day of grain and vegetables. These estimates correspond to conversion factors of .00082 acres per calorie for meat and .00016 acres per calorie for grain and vegetables. Thus, just the increase from 138 to 195 pounds of meat consumed per person per year in the U.S. means that about a

tenth of an acre of land more is required per person to meet our food consumption needs. Before we even consider any other farmland increases, this corresponds to almost 30 million acres of land that must be used for agriculture that could be used for other purposes or allowed to remain wild.

Of course, some people might point out that not all land is equal. There are pieces of land in the U.S. that can support ranching quite well, and that are not environmentally damaged by its use. For instance, some High Plains grasslands are ideally suited to bison (American buffalo) ranching. The bison do not overgraze, the land remains as a grassland because of their grazing, other animals and plants would benefit from this use. This neglects, of course, the fact that we consume mostly beef and very little bison in this country. Contrary to popular images in movies, cattle spend very little of their time out on the open range grazing on grass. In today's industrial ranching reality, cattle put on most of their weight by consuming silage (grain) while packed in dense feedlots. This type of ranching relies heavily on growing corn and other grain to feed the cattle, and on the liberal use of antibiotics to stave off diseases that the cattle get from living in such close quarters. This, too, has an environmental impact, as we now have measurable dosages of antibiotics in our rivers and streams from the runoff from these feedlots.

### Additional Reading

The following link provides information on food and nutrition from the U.S. Department of Agriculture. The site is maintained through the Consumer Information Center in Pueblo, Colorado.

	<p><b>Topic:</b> The Food Pyramid <b>Summary:</b> Contains information about food and nutrition. <b>Link:</b> <a href="http://www.pueblo.gsa.gov/cic_text/food/food-pyramid/main.htm">http://www.pueblo.gsa.gov/cic_text/food/food-pyramid/main.htm</a></p>
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### References

- 1 <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/obese/obse99.htm>, October 12, 2004
- 2 <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm>, October 12, 2004
- 3 USDA Agricultural Factbook 2001-2002, Chapter 2, <http://www.usda.gov/factbook/chapter2.htm>
- 4 <http://www.ers.usda.gov/publications/aer772/aer772d.pdf>, October 13, 2004.

### Activity

In this exercise, you will investigate how your own diet affects the agricultural demands of a country. You will do this by monitoring your food and drink intake for 3 days, and recording it on the attached activity sheet. At the end of this time, you will add up the number of calories consumed and find the average amount for each day. Most of your packaged food should come with some type of caloric guidelines. If it does not, a fairly complete listing of the calories of various foodstuffs can be found [here](#).

As best you can, you need to categorize the calories as coming from either plants or animals. For some things, this will be easy. A steak or a glass of milk clearly fall into the animal calories category, while a bowl of rice or a side dish of beans fall into the plant calories category. But what about plate of spaghetti with meat sauce? For this, you should try to separate the meat sauce into the amount of meat and the amount of tomato and other vegetables and then decide of calories for both. If you are in doubt, put the calories in the plant calories category. If you do this, you then need to realize that your land usage estimate might be lower than it actually is.

After calculating your average caloric intake and estimating the amount of land that is needed to provide your daily intake, answer the questions on the activity sheet.

# ESA21: Environmental Science Activities

Activity Sheet  
Calories and Land

Name: \_\_\_\_\_

Meal	Day 1			Day 2			Day 3		
	Item	Calories		Item	Calories		Item	Calories	
		Plant	Animal		Plant	Animal		Plant	Animal
Breakfast									
Lunch									
Dinner									
Total	xxxxxx			xxxxxx			xxxxxx		

Average plant calories = \_\_\_\_\_ Average animal calories = \_\_\_\_\_ Average calories = \_\_\_\_\_

Land usage = Plant calories \_\_\_\_\_ x .00016 acres/calorie + animal calories \_\_\_\_\_ x .00082 acres/calorie  
= \_\_\_\_\_ acres

- 1) How does your average consumption of calories compare to the current American average of 2700 calories per day?
- 2) There are 290 million people in the U.S. If all of them ate like you did, how much land would be required for farming?
- 3) China has 1.2 billion people. There is a total of 2.37 billion acres of land in China, of which only 710 million is of agricultural quality. If all of the Chinese had a diet like yours, how much land would be needed? Is it realistic for them to eat this much?