Humans are Denser than You Thought

Population density?, or intelligence? Maybe both.

How many persons live in a square mile of the Earth's surface *on the average*? This question asks how big is D in:

$$D \equiv \frac{world\ population}{Earth\ surface\ area} \cong \frac{6{,}856{,}000{,}000\ persons}{196{,}000{,}000\ mi^2} \cong 35\ \frac{persons}{mi^2}$$

Think awhile about this amount and try to visualize one square mile!!

This is computed before we have corrected for the percentage of the surface covered by water (70.8%), i.e. $196{,}000{,}000\ mi^2$ is $4\pi R^2$ using $R \cong 3{,}955\ mi$, (the Earth's radius varies between $3950\ mi$ and $3963\ mi$ with a slight equatorial bulge). Thus

$$D = \frac{35}{.292}\frac{persons}{mi^2} \cong 120\ \frac{persons}{mi^2}$$

Looks pretty big to me. It is the *average* population density on land for the Earth**.** In metric units, one $\boldsymbol{mi^2}$ is $\boldsymbol{2.589988.11\ km^2}$.

$$D = 46.33\ \frac{persons}{km^2}$$

Convert to acres using one $mi^2 = 640\ acres$:

$$D = \frac{3}{16}\ \frac{persons}{acre}$$

This is $5\frac{1}{3}$ acres per person. My wife and I live in typical US suburb near Atlanta and share $\frac{1}{3}$ acre. Think awhile about this and try to visualize an acre of land.

Now try to correct for the percentage of the land surface habitable by mankind. High mountains and hot deserts are not habitable. That land which is habitable also must have annexed to it absolutely essential land for agriculture.

What percent of the land mass is suitable for human habitation?

Less than 1% of the land mass (29.2 % of the Earth's surface area) is occupied by people living in dwellings.

of the remaining 28.2% ,

40% is wilderness
14% is desert (hot)
15% is desert-like (arid)
9% is Antarctica

This only totals to 78% of the land mass. The remaining 22% of 28.2% is dedicated to agriculture. If we use: $1/100$ of the land is lived in by humans, then we find $5/100$ acres per person. An acre is 43,560 square feet. So we have 2,178 square feet per person. My house is modestly large at ~1,700 square feet per floor and is shared by my wife and two dogs. So I actually use up my allotment just for housing if everybody is treated equally. Our $1/3$ of an acre for grass, flowers, trees and wildlife isn't available to me as *habitation space* if land division is done equitably over the whole planet. Think awhile about this.

For comparison recall the density on land without accounting for terrain:

$$D = 120\ \frac{persons}{mi^2}$$

Accounting for terrain increases this 100 fold (divide by 0.01), to

$$D = 12{,}000\ \frac{persons}{mi^2}$$

Yet Macau (China) has a density of 48,000 $\frac{persons}{mi^2}$, and half a million persons, and Hong Kong has a density of 16,000 $\frac{persons}{mi^2}$, and 7 million persons, and Bangladesh has a density of 3,000 $\frac{persons}{mi^2}$, and 162,000,000 persons, and China has a density of 361 $\frac{persons}{mi^2}$, and 1,338,712,972 persons, and the United States has a density of 83 $\frac{persons}{mi^2}$, and 309,000,000 persons in 3,700,000 square miles. The total land area of the Earth is $0.292 \times 196{,}000{,}000$ ($\sim 57{,}000{,}000$) square miles. See Table. The US has $3.7/57$ or 6.5 percent of all the land mass and only $0.309/6.856$ or 4.5 percent of the human population. I thought the difference would be greater before doing the calculation (note that $4.5/6.5 \times 120 = 83$). Think awhile about this too.*

Since there is 22 times as much agricultural land as there is land for human habitation, each of us has an equal share of agricultural land equal to $\sim 22 \times 2{,}178$ square feet, or *about one acre*. So we see that we get a bit over 5 acres per person if we consider all types of land, but only a little over an acre of arable land per person. Instead of dividing by 0.01 above (habitation only), divide by 0.22 (agricultural land) which increases the density 4.4 fold, to

$$D = 528\ \frac{persons}{mi^2}$$

This amount of land per person is feasible for individually growing plant foods, at least seasonally. Raising large ruminating live stock, on the other hand, would require a group of persons sharing their lands so enough grazing area is available per animal, while avoiding overgrazing when the animal density is too high. *Seasonality* forces cooperativity if everyone wants to survive year round. Thus the density dictates how agriculture should be structured.

Think about how we do agriculture today using very few farmers, numerous poorly remunerated vegetable harvesters and fruit pickers, much modern equipment and complex agricultural procedures, organized as large international companies, yielding large surpluses. In some locales on Earth agriculture is still practiced primitively, and in others there are large amounts of starvation. Each of

us should realize that about one acre of arable land is our personal share of the World, *on the average*.

* Continental densities (populations for 2006 – 2009)

Continent	Population	Area	Density
Antartica	0	5,400,000 mi^2	0/mi^2
Africa	1,000,010,000	11,668,600 mi^2	85.7/mi^2
Asia	3,879,000,000	17,212,000 mi^2	225.4/mi^2
Australia	22,392,000	2,941,300 mi^2	7.6/mi^2
S. America	385,743,000	6,890,000 mi^2	56.0/mi^2
N. America	528,721,000	9,540,000 mi^2	55.4/mi^2
Europe	731,000,000	3,930,000 mi^2	186/mi^2

Ronald F. Fox
Smyrna, Georgia
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