Examining the Correlation Between GDP per Capita and Deforestation in 2005 in 38 Countries

Introduction

A country's treatment of its environment is dictated by a multitude of factors – the domestic economy, foreign investment, agricultural demands, citizen education, etc. However, examining the domestic deforestation percentage of a government in comparison to the gross national income per capita sheds light on the citizens' environmental standpoints, national regard for the environment, and the effect that the economy's development, or lack thereof, has. Such an examination is crucial to understanding environmental policy, and whether or not there is dissonance between the government's actions towards the environment and their policy and whether or not the gross national income impacts it.

CXT: The broader and relevant issue of EVS is given but not discussed.

GDP per capita – Gross Domestic Product per capita. This is the value of the economy divided equally among the population.

Deforestation is the industrial removal or clearing of land for agricultural and infrastructural purposes or for the utilization of natural resources.

Research question

What is the correlation between 38 countries' domestic deforestation percentage and their GDP per capita?

CXT: The research question is given, but it is not focused. Which 38 countries?

Hypothesis

If a country has a high GDP per capita relative to the rest of the countries, it will deforest more due to a higher level of industry, economic development and social organization. The same applies to countries with a medium GDP per capita due to the fact that countries with a middle income usually are going through an industrial revolution or agricultural development. However, if a country has a low GDP per capita it will not have a high deforestation rate due to an assumed lack of governmental/social organization and technological/scientific development.

Variables

Independent – the amount deforested in a country.

Dependent – GDP per capita.

Apparatus

- A list of approximately 40 countries
- "Deforestation in m^3" from Gapminder
- "Forest Land, Total Area (ha)" from Gapminder
- "GDP/capita (fixed 2000 $US)" from Gapminder
- Microsoft Excel

Plan

1. Create a list of approximately 10 countries from every continent.
2. Download the list of all countries and their deforestation in cubic metres into Microsoft Excel from www.gapminder.org.
3. Choose selected countries from the list and delete the rest of the data from the deforestation spreadsheet.
4. Convert the data from cubic metres to hectares.
5. Download the Forest Land, Total Area (ha)" spreadsheet from www.gapminder.com and paste it into the column next to the country's deforestation in hectares.
6. Calculate the percentage of deforestation per country in order to compare the relative amount of deforestation between countries.
7. Download "GDP/capita (fixed 2000 $US)", using the column from 2005 and deleting the rest of the columns.
8. Select countries from the original list of approximately 40 countries.
9. Place these in a column next to the column of percentages of domestic deforestation.
10. Create a scatter graph.
11. Observe any patterns or trends in the data.

PLA: A sampling strategy is described but not justified.

PLA: It is not clear how these countries were selected in the first place.

Calculations

Conversion of cubic metres to hectares

The Global Forest Resources Assessment 2000, published by the Food and Agriculture Organisation (FAO), was consulted in order to determine the conversion factors necessary to convert cubic metres into hectares. For example, total wood product removal for Argentina in 2005, according to Table 1, was 11,026,000 cubic metres. The FAO table indicates that for that same country, on average a hectare of forest will produce 25 cubic metres. Dividing the first figure by the second gives a result of 441,040 hectares of forest removed in 2005 for Argentina. Excel copy features were used to generate the rest of the data.

Woods products removed as a percentage of forested land

In Table 2, the results of the previous calculations were divided by the forested land data and multiplied by 100 to generate a percentage. Following the example for Argentina, (441,040 ÷ 33,021,000) × 100 = 1.3%. Excel copy features were used to generate the remaining calculations.

Table 1

RAC: The data is clearly presented.

A table to show the amount of forested land in hectares, the amount of wood products removed in cubic metres, and per capita GDP in dollars. All data are for the year 2005.

Country	Forested land 2005 (ha)	Wood products removal 2005 (m^3)	Per capita GDP (USD $)	Conversion factor (m^3/ha)*
Argentina	33,021,000	11,026,000	8108	25
Australia	163,678,000	29,826,000	23929	55
Belarus	7,894,000	8,568,000	1871	153
Belize	1,653,000	216,000	3705	202
Bhutan	3,195,000	277,000	975	163
Bolivia	58,740,000	620,000	1069	114
Brazil	477,698,000	290,476,000	3977	131
Canada	310,134,000	223,500,000	25438	120
Chile	16,121,000	48,867,000	5979	160
China	197,290,000	135,435,000	1464	52
Colombia	60,728,000	10,275,000	2772	108
Cuba	2,713,000	2,195,000	3470	71
Dominican Republic	1,376,000	646,000	3080	29
Ecuador	10,853,000	8,339,000	1562	121
Egypt	67,000	240,000	1600	108
Ethiopia	13,000,000	111,861,000	149	56
Honduras	4,648,000	15,576,000	1297	58
Italy	9,979,000	9,600,000	19782	145
Kenya	3,522,000	26,658,000	427	35
South Korea	6,265,000	4,074,000	13802	41
Laos	16,142,000	7,424,000	407	29
Mexico	64,238,000	8,351,000	5983	52
Morocco	4,364,000	949,000	1531	27
New Zealand	8,309,000	24,687,000	15172	125
Papua New Guinea	29,437,000	8,364,000	626	34
Peru	68,742,000	10,789,000	2374	158
Romania	6,370,000	17,300,000	2260	213
Samoa	171,000	11,000	1742	100
Sierra Leone	2,754,000	6,551,000	234	143
South Africa	9,203,000	17,741,000	3398	49
Spain	17,915,000	17,689,000	15701	44
Sweden	27,528,000	76,780,000	31271	107
Switzerland	1,221,000	6,958,000	36737	337
Thailand	14,520,000	49,000	2360	17
United Kingdom	2,845,000	8,895,000	28354	128
United States	303,089,000	540,838,000	37718	136
Uruguay	1,506,000	4,900,000	6967	100
Vietnam	12,931,000	23,735,000	543	38

All data obtained from Gapminder.org.

* Country-specific conversion factors obtained from: FAO. Global Forest Resources Assessment 2000. Appendix 3, Table 7. http://www.fao.org/docrep/004/y1997e/y1997e1u.htm#bm66

Table 2
A table to show the amount of wood products removal in hectares and the same amount as a percentage of total forested land.

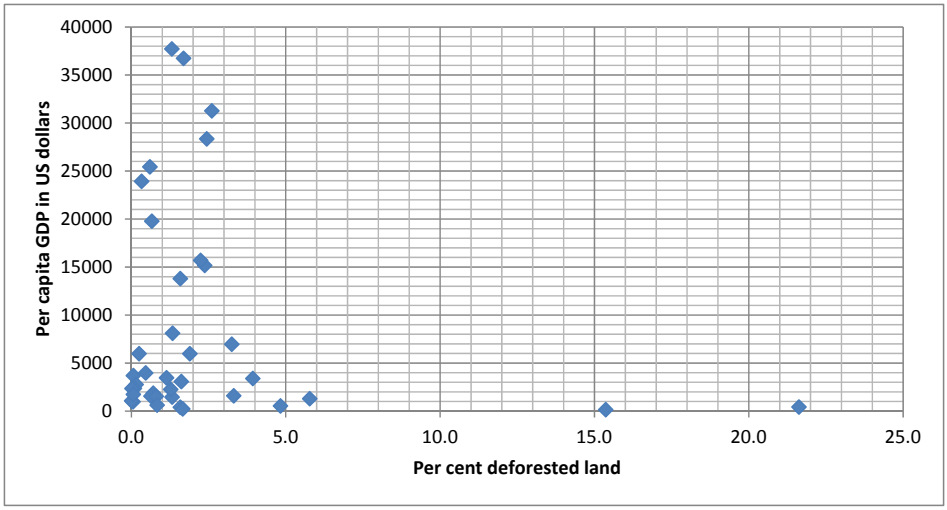
Country	Wood products removal (ha) *	Wood products removal as a percentage of forested land (%) **	Per capita GDP (USD $)
Argentina	441,040	1.3	8108
Australia	542,291	0.3	23929
Belarus	56,000	0.7	1871
Belize	1,069	0.1	3705
Bhutan	1,699	0.1	975
Bolivia	5,439	0.0	1069
Brazil	2,217,374	0.5	3977
Canada	1,862,500	0.6	25438
Chile	305,419	1.9	5979
China	2,604,519	1.3	1464
Colombia	95,139	0.2	2772
Cuba	30,915	1.1	3470
Dominican Republic	22,276	1.6	3080
Ecuador	68,917	0.6	1562
Egypt	2,222	3.3	1600
Ethiopia	1,997,518	15.4	149
Honduras	268,552	5.8	1297
Italy	66,207	0.7	19782
Kenya	761,657	21.6	427
South Korea	99,366	1.6	13802
Laos	256,000	1.6	407
Mexico	160,596	0.3	5983
Morocco	35,148	0.8	1531
New Zealand	197,496	2.4	15172
Papua New Guinea	246,000	0.8	626
Peru	68,285	0.1	2374
Romania	81,221	1.3	2260
Samoa	110	0.1	1742
Sierra Leone	45,811	1.7	234
South Africa	362,061	3.9	3398
Spain	402,023	2.2	15701
Sweden	717,570	2.6	31271
Switzerland	20,647	1.7	36737
Thailand	2,882	0.0	2360
United Kingdom	69,492	2.4	28354
United States	3,976,750	1.3	37718
Uruguay	49,000	3.3	6967
Vietnam	624,605	4.8	543

* Data calculated by dividing wood products removal by the corresponding conversion factor.
** Data calculated by dividing the results of wood products removal (ha) by forested land (ha).

Figure 1

A scatter graph to show the relationship between per cent deforested area and per capita GDP.

RAC: The use of a scatter graph is a good choice when trying to show a correlation



Upon plotting linear, logarithmic, exponential and polynomial regression lines, together with their respective R^2 values, all show no correlation at all between the two variables. Consequently, no line of best fit has been plotted.

RAC: This is probably true, but carrying out the calculation of R^2 would have been useful to see.

Conclusion

It is evident that there is no discernible correlation between the domestic deforestation percentage in 38 countries and their GDP per capita. Excel functions were used to plot trend lines for the data using all available models (linear, logarithmic, exponential and polynomial). The same function was used to calculate R^2 for each of these models, providing an estimate of how well the data are correlated between them. These correlation statistics were close to zero, indicating that there is no correlation between per capita GDP and the total amount of deforested land.

RAC: The absence of a correlation is the correct interpretation of the data and this has been justified.

There is no clear correlation or distinct line suggesting a direct relationship between deforestation percentages and gross national income per capita. Two countries with very low per capita GDP have very high percentages of wood product removal relative to forested land. Kenya and Ethiopia stand out with per capita GDP of $427 and $149 respectively but wood product removal percentages of 21.6 and 15.4, also respectively. This may be due to gathering of wood for household fuel, which can also contribute to desertification. However, this study gathered no data on this phenomenon and so this is only speculation. Removal of these two outliers does not change R^2 values significantly, and the remaining data continues to show a lack of correlation between these two factors.

DEV: This is a valid interpretation, but the student has missed the point that wood product removal might not necessarily lead to deforestation.

Some poor countries, such as Morocco, have very small amounts of deforestation but this may have to do with climate and the amount of wood products produced by the country. Other, wealthier, nations, like Sweden, have middle values of deforestation but this may be explained by Sweden's fame in protecting the environment and more restrictive legislation that promotes rational exploitation and/or conservation. Wealthier countries may have progressed beyond the need to deforest huge amounts of land and have also had the means and ability to

increase their consideration towards the environment and also spread environmental awareness. They are also able to invest in different sources of energy, such as solar, wind or nuclear, meaning that coal is not the only option.

However, countries with a middle GDP relative to the high and low of these 38 countries are probably in a process of industrialization or growth without environmental awareness. In order to fuel their industrial progress, they are required to deforest large amounts of their domestic forestland and do not have the awareness of the damage or means for alternative energy.

Evaluation

This experiment would likely find more accurate results if more countries were included. Gapminder includes all countries in their spreadsheets but there is not always data for them, meaning that throughout the process of collecting data several countries were weeded out. Starting out with a higher number of countries would decrease this problem.

DEV: Weaknesses are identified, but no attempt to suggest other sources of data is made. Not only would this give access to more countries, but it would provide the means of evaluating the data.

The reliability of the domestic deforestation data is questionable for two reasons. First, it would be difficult to access such information on poor or disorganized countries due to a lack of proper recording; and second, governments may have manipulated the data they presented in order to appear to deforest less or more. This would skew the data and make it less reliable. Also, using GDP per capita can be interpreted to be a poor reflection of a country's actual wealth standard, especially considering countries such as Brazil that have large wealth gaps and unequal wealth distributions.

DEV: There is an attempt to evaluate the conclusion, but this is not detailed enough.

Word count: 1745

APP: There is no section on applications.