Report for ForestQuery into Global Deforestation, 1990 to 2016

ForestQuery is on a mission to combat deforestation around the world and to raise awareness about this topic and its impact on the environment. The data analysis team at ForestQuery has obtained data from the World Bank that includes forest area and total land area by country and year from 1990 to 2016, as well as a table of countries and the regions to which they belong.

The data analysis team has used SQL to bring these tables together and to query them in an effort to find areas of concern as well as areas that present an opportunity to learn from successes.

## 1. **GLOBAL SITUATION**

According to the World Bank, the total forest area of the world was 41282694.9km² in 1990. As of 2016, the most recent year for which data was available, that number had fallen to39958245.9km², a loss of 1324449km², or 3.20%.

The forest area lost over this time period is slightly more than the entire land area of Australia

listed for the year 2016 (which is 1250590km²).

## 2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 31.34%. The region with the highest relative forestation was Latin America & Caribbean, with 46.16%, and the region with the lowest relative forestation was Middle East & North Africa, with 2.06% forestation.

In 1990, the percent of the total land area of the world designated as forest was 32.21%. The region with the highest relative forestation was Latin America & Caribbean, with 51.02%, and the region with the lowest relative forestation was Middle East & North Africa, with 1.77% forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016:

|  |  |  |
| --- | --- | --- |
| Region | 1990 Forest Percentage | 2016 Forest Percentage |
| Latin America & Caribbean | 51.02 | 46.16 |
| Europe & Central Asia | 37.28 | 38.04 |
| North America | 35.65 | 36.03 |
| World | 32.42 | 31.37 |
| Sub-Saharan Africa | 30.67 | 28.78 |
| East Asia & Pacific | 25.77 | 26.35 |
| South Asia | 16.51 | 17.50 |
| Middle East & North Africa | 1.77 | 2.06 |

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.02 % to 46.16%) and Sub-Saharan Africa (30.67% to 28.78%). All other regions actually increased in forest area over this time period. However, the drop in forest area in the two aforementioned regions was so large, the percent forest area of the world decreased over this time period from 32.42 % to 31.37%.

## 3. **COUNTRY-LEVEL DETAIL**

### SUCCESS STORIES

There is one particularly bright spot in the data at the country level, China. This country actually increased in forest area from 1990 to 2016 by 527229.06km². It would be interesting to study what has changed in this country over this time to drive this figure in the data higher. The country with the next largest increase in forest area from 1990 to 2016 was the United States, but it only saw an increase of 79200km², much lower than the figure for China.

China and United States are of course very large countries in total land area, so when we look at the largest *percent* change in forest area from 1990 to 2016, we aren’t surprised to find a much smaller country listed at the top. Iceland increased in forest area by 213.66% from 1990 to 2016.

### LARGEST CONCERNS

Which countries are seeing deforestation to the largest degree? We can answer this question in two ways. First, we can look at the absolute square kilometer decrease in forest area from 1990 to 2016. The following 3 countries had the largest decrease in forest area over the time period under consideration:

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

|  |  |  |
| --- | --- | --- |
| Country | Region | Absolute Forest Area Change |
| Brazil | Latin America & Caribbean | -541510 |
| Indonesia | East Asia & Pacific | -282193.9844 |
| Myanmar | East Asia & Pacific | -107234.0039 |
| Nigeria | Sub-Saharan Africa | -106506.00098 |
| Tanzania | Sub-Saharan Africa | -102320 |

The second way to consider which countries are of concern is to analyze the data by percent decrease.

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

|  |  |  |
| --- | --- | --- |
| Country | Region | Pct Forest Area Change |
| Togo | Sub-Saharan Africa | -61.7999309388418 |
| Nigeria | Sub-Saharan Africa | -59.1286034729531 |
| Uganda | Sub-Saharan Africa | -46.7469879518072 |
| Mauritania | Sub-Saharan Africa | -45.0344149459194 |
| Honduras | Latin America & Caribbean | -43.4507320933914 |

When we consider countries that decreased in forest area the most between 1990 and 2016, we find that four of the top 5 countries on the list are in the region of Sub-Saharan Africa. The countries are Togo, Nigeria, Uganda and Mauritania. The 5th country on the list is Honduras , which is in the Latin America & Caribbean region.

From the above analysis, we see that Nigeria is the only country that ranks in the top 5 both in terms of absolute square kilometer decrease in forest as well as percent decrease in forest area from 1990 to 2016. Therefore, this country has a significant opportunity ahead to stop the decline and hopefully spearhead remedial efforts.

### QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

|  |  |
| --- | --- |
| Quartile | Number of Countries |
| 1 (<=25%) | 85 |
| 2 (<=50%) | 73 |
| 3 (<=75%) | 38 |
| 4 (25% >) | 9 |

The largest number of countries in 2016 were found in the 1’st (<=25%) quartile.

There were 9 countries in the top quartile in 2016. These are countries with a very high percentage of their land area designated as forest. The following is a list of countries and their respective forest land, denoted as a percentage.

Table 3.4: Top Quartile Countries, 2016:

|  |  |  |
| --- | --- | --- |
| Country | Region | Pct Designated as Forest |
| Suriname | Latin America & Caribbean | 98.26 |
| Micronesia, Fed. Sts. | East Asia & Pacific | 91.86 |
| Sub-Saharan Africa | Sub-Saharan Africa | 90.04 |

## 5. RECOMMENDATIONS

*Write out a set of recommendations as an analyst on the ForestQuery team.*

* *What have you learned from the World Bank data?*
* *Which countries should we focus on over others?*

The total forest area of the world reduced by 3.20% from 1990 to 2016. Areas such as Latin America & Caribbean had the highest relative forestation in 2016 with 46.16% Forestation, down from its highest relative forestation in 1990 51.02%. Though this doesn’t seem substantial with a 4.86% disparity between the 26-year gap, the impact of the Latin America & Caribbean regional forestation deficit is substantial enough to be a primary factor in the 2016 forest area of the world’s reduction, from 1990. Although the region of Latin America & Caribbean plays an important role in these figures, it is important to focus on countries that had the most notable decrease in forest area between 1990 and 2016, including Togo, Nigeria, Uganda, Mauritania and Honduras. Four of these 5 countries are situated in the Sub-Saharan Africa and one (Honduras) resides within the Latin America & Caribbean region.

In light of this, a primary focus should be placed on the region in which the courtiers noted for forestation decay reside, the Sub-Saharan Africa region. In addition to this, the country of Honduras which is situated in the Latin America & Caribbean region should be of interest, resultant to this country having one of the top 5 notable decreases in forestation between 1990 and 2016 in a region that has maintained its position of having the highest relative forestation. It would be interesting to see how Honduras has contributed towards its Latin America & Caribbean regional deficit of 4.86% between 1990 and 2016.

## APPENDIX: SQL Queries Used

Deforestation Exploration

Joe Karl Magnussen

Udacity SQL Nanodegree Notes:

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PART 1 - GLOBAL SITUATION

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Temporary Table:

CREATE VIEW forestation AS SELECT f.country\_code AS country\_code, f.country\_name AS country\_name, f.year, f.forest\_area\_sqkm AS forest\_area\_sq\_km, l.total\_area\_sq\_mi\*2.59 AS land\_area\_sq\_km, r.region, r.income\_group, (f.forest\_area\_sqkm\*100)/(l.total\_area\_sq\_mi\*2.59) AS per\_forest\_area\_sqkm FROM forest\_area f JOIN land\_area l on f.country\_code = l.country\_code AND f.year = l.year JOIN regions r ON r.country\_code = f.country\_code;

a. What was the total forest area (in sq km) of the world in 1990? Please keep in mind that you can use the country record denoted as “World" in the region table.

SELECT \*

FROM forestation

WHERE country\_name = 'World'

AND year = 1990;

OUTPUT: 41282694.9

b. What was the total forest area (in sq km) of the world in 2016? Please keep in mind that you can use the country record in the table is denoted as “World.”

SELECT \*

FROM forestation

WHERE country\_name = 'World'

AND year = 2016;

OUTPUT: 39958245.9

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?

SELECT (SELECT forest\_area\_sq\_km

FROM forestation

WHERE country\_name = 'World'

AND year = 1990) - (SELECT forest\_area\_sq\_km

FROM forestation

WHERE country\_name = 'World'

AND year = 2016) AS difference;

OUTPUT: 1324449

d. What was the percent change in forest area of the world between 1990 and 2016?

SELECT (1-((SELECT forest\_area\_sq\_km

FROM forestation

WHERE country\_name = 'World'

AND year = 2016) / (SELECT forest\_area\_sq\_km

FROM forestation

WHERE country\_name = 'World'

AND year = 1990)))\*100 AS percentage;

OUTPUT: 3.20824258980245

e. If you compare the amount of forest area lost between 1990 and 2016, to which country's total area in 2016 is it closest to?

SELECT \* FROM forest\_area WHERE forest\_area\_sqkm <= 1324449 AND year = 2016 ORDER BY forest\_area\_sqkm DESC LIMIT 1;

OUTPUT: 1250590 - Australia

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PART 2 - REGIONAL OUTLOOK

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Answering these questions will help you add information into the template.

Use these questions as guides to write SQL queries.

Use the output from the query to answer these questions.

Create a table that shows the Regions and their percent forest area (sum of forest area divided by sum of land area) in 1990 and 2016. (Note that 1 sq mi = 2.59 sq km).

Based on the table you created, ...

a. What was the percent forest of the entire world in 2016?

SELECT (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 2016 ORDER BY perecent\_forest DESC LIMIT 1;

Output:

perecent\_forest

31.3441787357731

Which region had the HIGHEST percent forest in 2016, and which had the LOWEST, to 2 decimal places?

Which region had the HIGHEST percent forest in 2016?

SELECT region, (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 2016 GROUP BY region ORDER BY perecent\_forest DESC LIMIT 1;

Output:

region perecent\_forest

Latin America & Caribbean 46.1620721996047

and which had the LOWEST?

Output:

SELECT region, (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 2016 GROUP BY region ORDER BY perecent\_forest ASC LIMIT 1;

region perecent\_forest

Middle East & North Africa 2.06826486871501

b. What was the percent forest of the entire world in 1990? Which region had the HIGHEST percent forest in 1990, and which had the LOWEST, to 2 decimal places?

What was the percent forest of the entire world in 1990?

SELECT (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 1990 ORDER BY perecent\_forest DESC LIMIT 1;

Output:

perecent\_forest

32.2111306265193

Which region had the HIGHEST percent forest in 1990?

SELECT region, (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 1990 GROUP BY region ORDER BY perecent\_forest DESC LIMIT 1;

Output:

region perecent\_forest

Latin America & Caribbean 51.0299798667514

and which had the LOWEST?

SELECT region, (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 1990 GROUP BY region ORDER BY perecent\_forest ASC LIMIT 1;

region perecent\_forest

Middle East & North Africa 1.77524062469353

c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

SELECT region, (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 2016 GROUP BY region ORDER BY perecent\_forest DESC;

AND

SELECT region, (SUM(forest\_area\_sq\_km)/SUM(land\_area\_sq\_km)\*100) AS perecent\_forest FROM forestation WHERE year = 1990 GROUP BY region ORDER BY perecent\_forest DESC;

Output/ Findings:

Latin America and Caribbean (dropped from 51.02% to 46.16%) and Sub-Saharan Africa (30.67% to 28.78%)

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PART 3 - COUNTRY-LEVEL DETAIL

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top % change from 1990 - 2016?

WITH forest\_1990 AS (SELECT country\_code, year, country\_name, forest\_area\_sq\_km

FROM forestation

WHERE year = 1990),

forest\_2016 AS (SELECT country\_code, year, country\_name, forest\_area\_sq\_km FROM forestation WHERE year = 2016)

SELECT f16.country\_code, f16.country\_name,

f90.year AS year\_1990,

f16.year AS year\_2016,

f90.forest\_area\_sq\_km AS forest\_1990,

f16.forest\_area\_sq\_km AS forest\_2016, (f16.forest\_area\_sq\_km - f90.forest\_area\_sq\_km) AS forest\_area\_disparity, (f16.forest\_area\_sq\_km - f90.forest\_area\_sq\_km)\*100/(f90.forest\_area\_sq\_km) AS per\_change\_in\_forest\_area

FROM forest\_1990 f90

JOIN forest\_2016 f16

ON f90.country\_code = f16.country\_code

AND f90.country\_name = f16.country\_name

WHERE (f90.forest\_area\_sq\_km IS NOT NULL) AND (f16.forest\_area\_sq\_km IS NOT NULL)

AND (f16.country\_name != 'world')

ORDER BY per\_change\_in\_forest\_area DESC LIMIT 1;

Output:

country\_code country\_name forest\_area\_disparity per\_change\_in\_forest\_area

ISL Iceland 343.9999962 213.664588870028

a. Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?

WITH forest\_1990 AS (SELECT country\_code, year, country\_name, forest\_area\_sq\_km

FROM forestation

WHERE year = 1990),

forest\_2016 AS (SELECT country\_code, year, country\_name, forest\_area\_sq\_km FROM forestation WHERE year = 2016)

SELECT f16.country\_code, f16.country\_name,

f90.year AS year\_1990,

f16.year AS year\_2016,

f90.forest\_area\_sq\_km AS forest\_1990,

f16.forest\_area\_sq\_km AS forest\_2016, (f16.forest\_area\_sq\_km - f90.forest\_area\_sq\_km) AS forest\_area\_disparity

FROM forest\_1990 f90

JOIN forest\_2016 f16

ON f90.country\_code = f16.country\_code

AND f90.country\_name = f16.country\_name

WHERE (f90.forest\_area\_sq\_km IS NOT NULL) AND (f16.forest\_area\_sq\_km IS NOT NULL)

AND (f16.country\_name != 'world')

ORDER BY forest\_area\_disparity DESC LIMIT 6

Order BY land\_area\_sq\_km and then forest\_area\_disparity DESC?

b. Which 5 countries saw the largest percent decrease in forest area from 1990 to 2016? What was the percent change to 2 decimal places for each?

WITH forest\_1990 AS (SELECT country\_code, year, country\_name, forest\_area\_sq\_km

FROM forestation

WHERE year = 1990),

forest\_2016 AS (SELECT country\_code, year, country\_name, forest\_area\_sq\_km FROM forestation WHERE year = 2016)

SELECT f16.country\_code, f16.country\_name,

f90.year AS year\_1990,

f16.year AS year\_2016,

f90.forest\_area\_sq\_km AS forest\_1990,

f16.forest\_area\_sq\_km AS forest\_2016, (f16.forest\_area\_sq\_km - f90.forest\_area\_sq\_km) AS forest\_area\_disparity, (f16.forest\_area\_sq\_km - f90.forest\_area\_sq\_km)\*100/(f90.forest\_area\_sq\_km) AS per\_change\_in\_forest\_area

FROM forest\_1990 f90

JOIN forest\_2016 f16

ON f90.country\_code = f16.country\_code

AND f90.country\_name = f16.country\_name

WHERE (f90.forest\_area\_sq\_km IS NOT NULL) AND (f16.forest\_area\_sq\_km IS NOT NULL)

AND (f16.country\_name != 'world')

ORDER BY per\_change\_in\_forest\_area ASC LIMIT 6;

c. If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

SELECT DISTINCT(forestation\_quartiles),

COUNT(country\_name)

OVER (PARTITION BY forestation\_quartiles)

FROM (SELECT country\_name,

CASE WHEN per\_forest\_area\_sqkm <= 25

THEN 1 WHEN per\_forest\_area\_sqkm > 25

AND per\_forest\_area\_sqkm <= 50

THEN 2 WHEN per\_forest\_area\_sqkm > 50

AND per\_forest\_area\_sqkm <= 75 THEN 3

ELSE 4 END AS forestation\_quartiles

FROM forestation

WHERE year = 2016

AND (per\_forest\_area\_sqkm IS NOT NULL)) fq

Output:

forestation\_quartiles count

1 85

2 73

3 38

4 9

d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

SELECT region, ROUND(per\_forest\_area\_sqkm::numeric, 2) AS rounded, country\_name

FROM forestation WHERE year = 2016

AND (per\_forest\_area\_sqkm > 75)

ORDER BY rounded DESC;