

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.



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1. GLOBAL SITUATION

According to the World Bank, the total forest area of the world was 412,82,695 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,246 sqkm a loss of 1,324,449 sqkm, or 3.21%.

The forest area lost over this time period is slightly more than the entire land area of Peru listed for the year 2016 (which is 1,280,000 sqkm).

2. REGIONAL OUTLOOK

In 2016, the percent of the total land area of the world designated as forest was 31.38%. 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 2.07% forestation.

In 1990, the percent of the total land area of the world designated as forest was 32.42%. The region with the highest relative forestation was Latin America & Caribbean, with 51.03%, and the region with the lowest relative forestation was Middle East & North Africa, with 1.78% forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51.03%	46.16%
Europe & Central Asia	37.28%	38.04%
North America	35.65%	36.04%
World	32.42%	31.38%
Sub-saharan Africa	30.67%	28.79%
East Asia & Pacific	25.78%	26.36%
South Asia	16.51%	17.51%
Middle East & North Africa	1.78%	2.07%

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.03% to 46.16%) and Sub-saharan Africa (30.67% to 28.79%). 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 31.38%.

3. COUNTRY-LEVEL DETAIL

A. 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 527,229 sqkm or 33.55%. 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 79,200 or 2.62%, much lower than the figure for China.

China and the 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.

B. 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 5 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	541,510 sqkm
Indonesia	East Asia & Pacific	282,194 sqkm
Myanmar	East Asia & Pacific	107,234 sqkm
Nigeria	Sub-saharan & Africa	106,506 sqkm
Tanzania	Sub-saharan & Africa	102,320 sqkm

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	% Forest Area Change
Togo	Sub-saharan Africa	75%
Nigeria	Sub-saharan Africa	62%
Uganda	Sub-saharan Africa	59%
Mauritania	Sub-saharan Africa	47%
Honduras	Latin America & Caribbean	45%

When we consider countries that decreased in forest area percentage 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.

C. QUARTILES

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

Quartile	Number of Countries
0 - 25%	85
25 - 50%	72
50 - 75%	38
75 - 100%	9

The largest number of countries in 2016 were found in the 0-25% 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	% Designated as Forest
Suriname	Latin America & Caribbean	98.26%
Micronesia, Fed. Sts.	East Asia & Pacific	91.86%
Gabon	Sub-saharan Africa	90.04%
Seychelles	Sub-saharan Africa	88.41%
Palau	East Asia & Pacific	87.61%
American Samoa	East Asia & Pacific	87.50%
Guyana	Latin America & Caribbean	83.90%
Lao PDR	East Asia & Pacific	82.11%
Solomon Islands	East Asia & Pacific	77.86%

4. RECOMMENDATIONS

World Bank data

- The analysis performed above has been limited by the datasets available from the World Bank.
- While forest area and land area are useful measures in this analysis, there are also other things that should be considered which may be driving the change in forestation from 1990 - 2016.
- For example, country population would be a useful measure to analyse. As the population of a country increases, this may lead to the reduction of forests to make way for houses.

Countries we should focus on

- The countries we should focus on are those illustrated in the top 5 forest area decreases, in particular Brazil.
- In Brazil, the reduction in the forest area is largely attributable to the deforestation of the Amazon rainforest which not only reduces the forest area, but also destroys the biodiversity of many plants and animals.
- The Amazon rainforest in Brazil has an important part in regulating the world's oxygen and carbon cycles.
- For Indonesia, Myanmar, Nigeria and Tanzania, it is important to further understand what factors are leading to the change in forest area and how these can be mitigated to ensure that deforestation is reduced.

5. APPENDICES - SQL QUERIES

Initial forestation view creation:

```
CREATE VIEW forestation AS
SELECT fa.country_code,
       fa.country_name,
       fa.year,
       fa.forest_area_sqkm,
       la.total_area_sq_mi,
       la.total_area_sq_mi * 2.59 AS total_area_sqkm,
       ROUND((fa.forest_area_sqkm/(la.total_area_sq_mi * 2.59))*100, 2)AS
forest_as_percent_of_land,
       r.region,
       r.income_group
FROM forest_area fa
JOIN land_area la
ON fa.country_code = la.country_code AND fa.year = la.year
JOIN regions r
ON la.country_code = r.country_code;
```

Part 1 - Global situation

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 country_name, forest_area_sqkm
FROM forest_area
WHERE country_name = 'World'
AND year = 1990;
```

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 country_name, forest_area_sqkm
FROM forest_area
WHERE country_name = 'World'
AND year = 2016;
```


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

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

The below answers queries 1c and 1d:

```
--1990 forest area
WITH t1 AS(
SELECT country_name, forest_area_sqkm AS area_1990
FROM forest_area
WHERE country_name = 'World'
AND year = 1990
),
-- 2016 forest area
t2 AS(
SELECT country_name, forest_area_sqkm AS area_2016
FROM forest_area
WHERE country_name = 'World'
AND year = 2016
)
-- Working out the difference and percent change
SELECT area_2016, area_1990, area_2016-area_1990 AS area_change,
ROUND((area_2016-area_1990)/area_1990 *100, 2) AS area_percent_change
FROM t1, t2;
```

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 country_name, year, ROUND((total_area_sq_mi*2.59),0) AS total_area_sqkm
FROM land_area
WHERE year = 2016
AND (total_area_sq_mi*2.59) <
    ((SELECT forest_area_sqkm
    FROM forest_area
    WHERE country_name = 'World'
    AND year = 1990) -
    (SELECT forest_area_sqkm
    FROM forest_area
    WHERE country_name = 'World'
    AND year = 2016))
ORDER BY total_area_sq_mi DESC
LIMIT 1;
```

Part 2 - Regional outlook

a. What was the percent forest of the entire world in 2016? Which region had the HIGHEST percent forest in 2016, and which had the LOWEST, to 2 decimal places?

```
SELECT country_name, forest_as_percent_of_land
FROM forestation
WHERE country_name = 'World'
AND year = 2016;
```

```
SELECT region, ROUND((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100, 2) AS
region_percent
FROM forestation
WHERE year = 2016
GROUP BY 1
ORDER BY 2 DESC;
```

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?

```
SELECT country_name, forest_as_percent_of_land
FROM forestation
WHERE country_name = 'World'
AND year = 1990;
```

```
SELECT region, ROUND((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100, 2) AS
region_percent
FROM forestation
WHERE year = 1990
GROUP BY 1
ORDER BY 2 DESC;
```

Part 3: Country Level Detail:

To fill in the gaps in the template, this is the query I ran:

```
-- 1990 forest area
WITH t1 AS(
    SELECT country_name, year, forest_area_sqkm AS area_1990
    FROM forest_area
    WHERE forest_area_sqkm IS NOT NULL
    AND country_name <> 'World'
    AND year = 1990
    ORDER BY 3 DESC
),
-- 2016 forest area
t2 AS(
    SELECT country_name, year, forest_area_sqkm AS area_2016
    FROM forest_Area
    WHERE forest_area_sqkm IS NOT NULL
    AND country_name <> 'World'
    AND year = 2016
)
-- Difference between 1990 and 2016
SELECT t1.country_name, area_1990, area_2016, ROUND(area_2016 - area_1990,0) AS
area_difference, ROUND(((area_2016-area_1990)/area_1990 *100),2) AS
area_difference_percent
FROM t1
JOIN t2
ON t1.country_name = t2.country_name
ORDER BY 4 DESC
LIMIT 5;
```

**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?**

```
-- 1990 forest area
WITH t1 AS(
    SELECT country_name, region, forest_area_sqkm AS area_1990
    FROM forestation
    WHERE forest_area_sqkm IS NOT NULL
    AND country_name <> 'World'
    AND year = 1990
    ORDER BY 3 DESC
),
-- 2016 forest area
t2 AS(
    SELECT country_name, region, forest_area_sqkm AS area_2016
    FROM forestation
    WHERE forest_area_sqkm IS NOT NULL
    AND country_name <> 'World'
    AND year = 2016
    ORDER BY 3 DESC
)
-- Difference between two tables
SELECT t1.country_name, t1.region, area_1990, area_2016, ROUND(area_1990-area_2016,0)
AS area_difference
FROM t1
JOIN t2
ON t1.country_name = t2.country_name
ORDER BY 5 DESC
LIMIT 5;
```

**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?**

```
-- 1990 forest area
WITH t1 AS(
    SELECT country_name, region, forest_area_sqkm AS area_1990
    FROM forestation
    WHERE forest_area_sqkm IS NOT NULL
    AND country_name <> 'World'
    AND year = 1990
    ORDER BY 3 DESC
),
-- 2016 forest area
t2 AS(
    SELECT country_name, region, forest_area_sqkm AS area_2016
    FROM forestation
    WHERE forest_area_sqkm IS NOT NULL
    AND country_name <> 'World'
    AND year = 2016
    ORDER BY 3 DESC
)
-- Difference between the two
SELECT t1.country_name, t1.region, area_1990, area_2016, ROUND(area_1990-area_2016,0)
AS area_difference, ROUND((((area_1990-area_2016)/area_1990*100),0) AS area_percent
FROM t1
JOIN t2
ON t1.country_name = t2.country_name
ORDER BY 6 DESC
LIMIT 5;
```

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

```
-- 2016 table
WITH t1 AS(
    SELECT country_name, forest_as_percent_of_land
    FROM forestation
    WHERE year = 2016
    AND country_name <> 'World'
)
-- working out the quartiles
SELECT
COUNT(CASE WHEN t1.forest_as_percent_of_land <= 25 THEN 1 ELSE NULL END) AS
quartile_1,
COUNT(CASE WHEN t1.forest_as_percent_of_land > 25 AND t1.forest_as_percent_of_land <=
50 THEN 1 ELSE NULL END) AS quartile_2,
COUNT(CASE WHEN t1.forest_as_percent_of_land > 50 AND t1.forest_as_percent_of_land <=
75 THEN 1 ELSE NULL END) AS quartile_3,
COUNT(CASE WHEN t1.forest_as_percent_of_land > 75 THEN 1 ELSE NULL END) AS
quartile_4
FROM t1;
```

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

```
SELECT country_name, region, forest_as_percent_of_land
FROM forestation
WHERE year = 2016
AND country_name <> 'World'
AND forest_as_percent_of_land > 75
ORDER BY 3 DESC;
```

e. How many countries had a percent forestation higher than the United States in 2016?
94 countries

```
SELECT count(*)
FROM forestation
WHERE year = 2016
AND country_name <> 'World'
AND forest_as_percent_of_land > (SELECT forest_as_percent_of_land
    FROM forestation
    WHERE year = 2016
    AND country_name = 'United States');
```