

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 41282694.9 km² in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km², a loss of 1324449.0 km², or 3.2%.

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 1279999.9891 km²).

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 (%)
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
South Asia	16.51	17.51
Sub-Saharan Africa	30.67	28.79
World	32.42	31.38

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%), as highlighted in yellow in table 2.1. 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 527229.06 km². 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.

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 (km ²)
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234
Nigeria	Sub-Saharan Africa	106506
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	75.45
Nigeria	Sub-Saharan Africa	61.80
Uganda	Sub-Saharan Africa	59.27
Mauritania	Sub-Saharan Africa	46.75
Honduras	Latin America & Caribbean	45.03

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.

C. QUARTILES

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

Quartile	Number of Countries
0-25 (Q1)	85
25-50 (Q2)	73
50-75 (Q3)	38
75-100 (Q4)	9

The largest number of countries in 2016 were found in the 0-25 (Q1) 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
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

5. RECOMMENDATIONS

With the data presented here, we can see that many regions in the world experience an increase in forest areas, such as Europe, Central Asia, East Asia, the Pacific region, North America, South Asia, North Africa and the Middle East (Table 2.1). However, in total, world forest areas have decreased between 1990 and 2016 by 3.2%, or roughly an area equal to Peru. This shows the overall massive decreases stemming losses of forest area in Latin America and the Caribbean, and Sub-Saharan Africa.

I would recommend focusing first on the countries with the largest absolute forest area change, i.e. the countries that are reducing the most forest by land area, found in Table 3.1. The top 5 countries in this category are Brazil, Indonesia, Myanmar, Nigeria, and Tanzania. Still, as by percent change decrease the Sub-Saharan Africa region is also prominently affected (Table 3.2), this region should also be focused on. A way would be by partnering up with the success stories China and Iceland, and identify how they managed their forestation growth, as well as e.g. Suriname, in which almost the entire country is covered in forest to see how they maintain this vast forestation.

6. APPENDIX: SQL queries used

a. Create View

```
CREATE VIEW forestation
AS
SELECT fa.*,
       la.total_area_sq_mi * 2.59 AS total_area_sqkm,
       reg.region,
       reg.income_group,
       (fa.forest_area_sqkm / (la.total_area_sq_mi * 2.59)) AS perc_forested_area_sqkm
FROM forest_area AS fa
JOIN land_area AS la
ON fa.country_code=la.country_code AND fa.year=la.year
JOIN regions AS reg
ON la.country_code=reg.country_code;
```

b. SQL codes for global situation

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

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

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

```

SELECT (
  (SELECT forest_area_sqkm
   FROM forestation
   WHERE country_name = 'World'
   AND year = 1990) -
  (SELECT forest_area_sqkm
   FROM forestation
   WHERE country_name = 'World'
   AND year = 2016)) AS diff
FROM forestation;

```

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

```

SELECT (((
  (SELECT forest_area_sqkm
   FROM forestation
   WHERE country_name = 'World'
   AND year=1990) -
  (SELECT forest_area_sqkm
   FROM forestation
   WHERE country_name = 'World'
   AND year=2016)) / (
  (SELECT forest_area_sqkm
   FROM forestation
   WHERE country_name = 'World'
   AND year=1990))) *100) AS perc_dcrease
FROM forestation;

```

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,
       total_area_sqkm
FROM forestation
WHERE year = 2016
AND total_area_sqkm <= 1324449
ORDER BY total_area_sqkm DESC
LIMIT 1;

```

c. SQL codes for regional outlook

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

```
SELECT country_name,  
       ((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100) AS  
       perc_forest  
FROM forestation  
WHERE country_name = 'World'  
AND year = 2016  
GROUP BY country_name;
```

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

```
SELECT region,  
       Round(((Sum(forest_area_sqkm) /  
       Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS perc_forest  
FROM forestation  
WHERE year = 2016  
GROUP BY region  
ORDER BY perc_forest DESC  
LIMIT 1;
```

```
SELECT region,  
       Round(((Sum(forest_area_sqkm) /  
       Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS perc_forest  
FROM forestation  
WHERE year = 2016  
GROUP BY region  
ORDER BY perc_forest  
LIMIT 1;
```

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

```
SELECT country_name,  
       ((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100) AS  
       perc_forest  
FROM forestation  
WHERE country_name = 'World'
```



```
AND year = 1990
GROUP BY country_name;
```

Which region had the HIGHEST percent forest in 1990, and which had the LOWEST, to 2 decimal places?

```
SELECT region,
       Round(((Sum(forest_area_sqkm) /
               Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS perc_forest
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY perc_forest DESC
LIMIT 1;
```

```
SELECT region,
       Round(((Sum(forest_area_sqkm) /
               Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS perc_forest
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY perc_forest
LIMIT 1;
```

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

→ Filled in Table 2.1 with results from code below and read from there

```
SELECT region,
       Round(((Sum(forest_area_sqkm) /
               Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS perc_forest
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY region;
```

```

SELECT region,
       Round((((Sum(forest_area_sqkm) /
       Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS perc_forest
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY region;

```

d. SQL codes for country-level detail

Success stories: Which 2 countries saw the largest amount increase in forest area from 1990 to 2016?

```

WITH table1 AS
  (SELECT country_name,
        SUM(forest_area_sqkm) AS forest_area_1
   FROM forestation
   WHERE year = 1990
   GROUP BY country_name, forest_area_sqkm),
table2 AS
  (SELECT country_name,
        SUM(forest_area_sqkm) AS forest_area_2
   FROM forestation
   WHERE year = 2016
   GROUP BY country_name, forest_area_sqkm)
SELECT t1.country_name,
       (t1.forest_area_1 - t2.forest_area_2) AS forest_change
FROM table1 AS t1
JOIN table2 AS t2
ON t1.country_name = t2.country_name
ORDER BY forest_change
LIMIT 2;

```

Success stories: Which country saw the largest percent change increase in forest area from 1990 to 2016?

```
WITH table1 AS
  (SELECT country_name,
    (SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS
    percent_forestation_1
  FROM forestation
  WHERE year = 1990
  GROUP BY country_name, forest_area_sqkm),
table2 AS
  (SELECT country_name,
    (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 AS
    percent_forestation_2
  FROM forestation
  WHERE year = 2016
  GROUP BY country_name, forest_area_sqkm)
SELECT t1.country_name,
  Round((((t1.percent_forestation_1 -
    t2.percent_forestation_2)/(t1.percent_forestation_1))*100)::Numeric, 2) AS
  perc_change
FROM table1 AS t1
JOIN table2 AS t2
ON t1.country_name = t2.country_name
ORDER BY perc_change
LIMIT 1;
```

Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016?

What was the difference in forest area for each?

→ Results of table 3.1

```
WITH table1 AS
  (SELECT country_name,
    region,
    SUM(forest_area_sqkm) AS forest_area_1
  FROM forestation
  WHERE year = 1990
  GROUP BY country_name, forest_area_sqkm, region),
```

```

table2 AS
  (SELECT country_name,
         region,
         SUM(forest_area_sqkm) AS forest_area_2
   FROM forestation
   WHERE year = 2016
   GROUP BY country_name, forest_area_sqkm, region)
SELECT t1.country_name,
       t1.region,
       (t1.forest_area_1 - t2.forest_area_2) AS forest_change
FROM table1 AS t1
JOIN table2 AS t2
ON t1.country_name = t2.country_name
WHERE t1.forest_area_1 IS NOT NULL
AND t2.forest_area_2 IS NOT NULL
AND t1.country_name != 'World'
ORDER BY forest_change DESC
LIMIT 5;

```

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?

→ Results of table 3.2

```

WITH table1 AS
  (SELECT country_name,
         region,
         (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 AS
         percent_forestation_1
   FROM forestation
   WHERE year = 1990
   GROUP BY country_name, forest_area_sqkm, region),
table2 AS
  (SELECT country_name,
         region,
         (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 AS
         percent_forestation_2
   FROM forestation
   WHERE year = 2016
   GROUP BY country_name, forest_area_sqkm, region)

```

```

SELECT t1.country_name,
       t1.region,
       Round((((t1.percent_forestation_1-
               t2.percent_forestation_2)/(t1.percent_forestation_1))*100)::Numeric, 2) AS
       perc_change
FROM table1 AS t1
JOIN table2 AS t2
ON t1.country_name = t2.country_name
WHERE t1.percent_forestation_1 IS NOT NULL
AND t2.percent_forestation_2 IS NOT NULL
AND t1.country_name != 'World'
ORDER BY perc_change DESC
LIMIT 5;

```

If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016? → Results of table 3.3

```

WITH table1 AS
  (SELECT country_name,
         year,
         (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 AS
         percent_forestation
  FROM forestation
  WHERE year = 2016
  GROUP BY country_name, year, forest_area_sqkm)
SELECT DISTINCT(quartiles),
       COUNT(country_name) OVER(PARTITION BY quartiles)
FROM
  (SELECT country_name,
         CASE
           WHEN percent_forestation<25 THEN '0-25 (Q1)'
           WHEN percent_forestation>=25 AND percent_forestation<50 THEN '25-50 (Q2)'
           WHEN percent_forestation>=50 AND percent_forestation<75 THEN '50-75 (Q3)'
           ELSE '75-100 (Q4)'
         END AS quartiles
  FROM table1
  WHERE percent_forestation IS NOT NULL
  AND year = 2016) sub

```

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

```
WITH table2 AS
(WITH table1 AS
  (SELECT country_name,
         year,
         region,
         (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 AS
         perc_forestation
  FROM forestation
  WHERE year = 2016
  GROUP BY country_name, year, forest_area_sqkm, region)
  SELECT DISTINCT(quartiles),
         COUNT(country_name)OVER(PARTITION BY quartiles,
         country_name,
         region,
         perc_forestation
FROM
  (SELECT country_name,
         region,
         perc_forestation,
         CASE
         WHEN perc_forestation<=25 THEN '0-25 (Q1)'
         WHEN perc_forestation>25 AND perc_forestation<=50 THEN '25-50 (Q2)'
         WHEN perc_forestation>50 AND perc_forestation<=75 THEN '50-75 (Q3)'
         ELSE '75-100 (Q4)'
         END AS quartiles
  FROM table1
  WHERE perc_forestation IS NOT NULL
  AND year = 2016) sub)
SELECT country_name,
       region,
       Round(perc_forestation::Numeric, 2) AS perc_forestation
FROM table2
WHERE quartiles = '75-100 (Q4)'
ORDER BY perc_forestation DESC;
```