

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 sqkm** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 sqkm**, a loss of **(-)1324449 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 **1279999.9891 sqkm**).

2. REGIONAL OUTLOOK

In 2016, the percentage of the total land area of the world designated as a 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 the **Middle East & North Africa**, with **2.07%** forestation.

In 1990, the percentage of the total land area of the world designated as a 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 the **Middle East & North Africa**, with **1.78%** forestation.

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

Regions	Forest_area (1990)	Forest_area (2016)	Difference in Area
Latin America & Caribbean	51.03	46.16	-4.87
Europe & Central Asia	37.28	38.04	0.76
North America	35.65	36.04	0.39
World	32.42	31.38	-1.04
Sub-Saharan Africa	30.67	28.79	-1.88
East Asia & Pacific	25.78	26.36	0.58
South Asia	16.51	17.51	1
Middle East & North Africa	1.78	2.07	0.29

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** (dropped from **(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 percentage of forest area in 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 sqkm**. 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 **79200 sqkm**, much lower than the figure for **CHINA**.

CHINA and the **UNITED STATES** are of course vast 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	Forest_Area (1990)	Forest_Area (2016)	Absolute Forest Area Change
Brazil	Latin America & Caribbean	5467050	4925540	-541510
Indonesia	East Asia & Pacific	1185450	903256.02	-282193.98
Myanmar	East Asia & Pacific	392180	284946	-107234
Nigeria	Sub-Saharan Africa	172340	65834	-106506
Tanzania	Sub-Saharan Africa	559200	456880	-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	Forest_Area (1990)	Forest_Area (2016)	Pct_Forest Area_Change
Togo	Sub-Saharan Africa	6850	1682	-75.45
Nigeria	Sub-Saharan Africa	172340	65834	-61.8
Uganda	Sub-Saharan Africa	47510	19418	-59.13
Mauritania	Sub-Saharan Africa	4150	2210	-46.75
Honduras	Latin America & Caribbean	81360	44720	-45.03

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 the forest as well as the 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:

Quartiles	No 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 **Q1- first** 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	Percentage designated as forest
American Samoa	East Asia & Pacific	87.5
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Palau	East Asia & Pacific	87.61
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26
Seychelles	Sub-Saharan Africa	88.41

4. RECOMMENDATIONS

*In Latin America & the Caribbean and Sub-Saharan Africa, where forest area is dropping the most, the world lost **3.2%** of its total forest area between 1990 and 2016, an area larger than Peru. This reduction impacts the entire world since there is a high percentage of forest in these areas, even while the area of forest is growing in other areas.*

*However, countries like China and the United States have seen significant growth in their forest acreage, while comparable nations like Iceland have made significant efforts and seen success. Brazil exhibits a significant decline in forest acreage, while other countries have seen significant declines in forest percentage. Nigeria, for example, has had significant declines in both forest area and percentage. In the first quarter of forest area, **85** countries (less than 25%) are represented.*

*The last quarter only includes **9** countries (more than 75). The regions of Latin America & the Caribbean and Sub-Saharan Africa in particular should receive special consideration due to the countries there that have experienced the biggest reduction in forest area (as shown in the table above).*

5. APPENDIX: SQL Queries Used

*/*Create a View called “forestation” by joining all three tables - forest_area, Land_area and regions in the workspace.
The forest_area and Land_area tables join on both country_code AND year.
The regions table joins these based on only country_code.
In the ‘forestation’ View, include the following:*

*All of the columns of the origin tables
A new column that provides the percent of the Land area that is designated as forest.
Keep in mind that the column forest_area_sqkm in the forest_area table and the Land_area_sqmi in the Land_area table are in different units (square kilometers and square miles, respectively), so an adjustment will need to be made in the calculation you write (1 sq*

```
DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation AS
  (SELECT forest_area.country_code,forest_area.country_name,forest_area.year,
    forest_area.forest_area_sqkm,
    land_area.total_area_sq_mi*2.59 AS total_land_area,
    regions.region, regions.income_group,
    forest_area.forest_area_sqkm/(land_area.total_area_sq_mi*2.59)*100 AS total_land_percentage
  FROM forest_area
  JOIN land_area
  ON forest_area.country_code = land_area.country_code AND forest_area.year = land_area.year
  JOIN regions
  ON forest_area.country_code = regions.country_code);
```

```
--1. GLOBAL SITUATION
--(a). What was the total forest area (in sq km) of the world in 1990?
```

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

```
--(b). What was the total forest area (in sq km) of the world in 2016?
```

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

```
--BEST Way
WITH
area_2016 AS
  (SELECT forest_area_sqkm AS a_2016,year,country_name
   FROM forestation
   WHERE year = 2016 AND country_name = 'World'),
area_1990 AS
  (SELECT forest_area_sqkm AS a_1990,year,country_name
   FROM forestation
   WHERE year = 1990 AND country_name = 'World')
SELECT a_2016,a_1990
FROM area_1990,area_2016
```

```
--(c). 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 year = 2016 AND country_name = 'World')
-
  (SELECT forest_area_sqkm
   FROM forestation
   WHERE year = 1990 AND country_name = 'World') AS change;
```

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

```
WITH
areas_2016 AS
  (SELECT forest_area_sqkm AS a_2016,year,country_name
   FROM forestation
   WHERE year = 2016 AND country_name = 'World'),
areas_1990 AS
  (SELECT forest_area_sqkm AS a_1990
   FROM forestation
   WHERE year = 1990 AND country_name = 'World'),
change AS
  (SELECT a_1990,a_2016, a_2016 - a_1990 AS change,(a_2016-a_1990)/a_1990*100 AS percentage_change
   FROM areas_2016,areas_1990)
SELECT a_1990,a_2016, change, ROUND(percentage_change::NUMERIC,2) AS percentage_change
FROM change;
```

```
--(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 DISTINCT country_name,total_land_area
FROM forestation
WHERE total_land_area BETWEEN 1270000 AND 1330000;

--2. REGIONAL OUTLOOK
--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.
--Based on the table you created, ....
--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 region,ROUND((SUM(forest_area_sqkm)*100/SUM(total_land_area))::NUMERIC,2) AS percentage_2016
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percentage_2016 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 region,ROUND((SUM(forest_area_sqkm)*100/SUM(total_land_area))::NUMERIC,2) AS percentage_1990
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY percentage_1990 DESC;

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

WITH
percentage_2016 AS
    (SELECT region,ROUND((SUM(forest_area_sqkm)*100/SUM(total_land_area))::NUMERIC,2) AS Forest_area_2016
    FROM forestation
    WHERE year = 2016
    GROUP BY region
    ORDER BY Forest_area_2016 DESC),
percentage_1990 AS
    (SELECT region,ROUND((SUM(forest_area_sqkm)*100/SUM(total_land_area))::NUMERIC,2) AS Forest_area_1990
    FROM forestation
    WHERE year = 1990
    GROUP BY region
    ORDER BY Forest_area_1990 DESC),
j_percent_1990_2016 AS
    (SELECT *
    FROM percentage_2016
    JOIN percentage_1990
    USING (region))

SELECT Region,Forest_area_1990,Forest_area_2016,(Forest_area_2016-Forest_area_1990) AS Difference_in_Area
FROM j_percent_1990_2016;

--3. COUNTRY-LEVEL DETAIL
--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
area_2016 AS
    (SELECT region,country_name,ROUND(SUM(forest_area_sqkm)::NUMERIC,2) AS Forest_area_2016
    FROM forestation
    WHERE year = 2016 AND forest_area_sqkm IS NOT NULL
    GROUP BY 1,2
    ORDER BY Forest_area_2016 DESC),
area_1990 AS
    (SELECT region,country_name,ROUND(SUM(forest_area_sqkm)::NUMERIC,2) AS Forest_area_1990
    FROM forestation
    WHERE year = 1990 AND forest_area_sqkm IS NOT NULL
    GROUP BY 1,2
    ORDER BY Forest_area_1990 DESC),
f_area_1990_2016 AS
    (SELECT *
    FROM area_2016
    JOIN area_1990
    USING (region,country_name))
SELECT country_name,region,Forest_area_1990,Forest_area_2016,(Forest_area_2016-Forest_area_1990) AS Absolute_Forest_Area_Change
FROM f_area_1990_2016
WHERE country_name <> 'World'
ORDER BY Absolute_Forest_Area_Change
LIMIT 5;
```

/*NOTE:- with order by DESC we got country_name with highest figures of Absolute_forest_area_change which were CHINA & THE USA.*/

--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
area_2016 AS
    (SELECT region,country_name,ROUND(SUM(forest_area_sqkm)::NUMERIC,2) AS Forest_area_2016
    FROM forestation
    WHERE year = 2016 AND forest_area_sqkm IS NOT NULL
    GROUP BY 1,2
    ORDER BY Forest_area_2016 DESC),
area_1990 AS
    (SELECT region,country_name,ROUND(SUM(forest_area_sqkm)::NUMERIC,2) AS Forest_area_1990
    FROM forestation
    WHERE year = 1990 AND forest_area_sqkm IS NOT NULL
    GROUP BY 1,2
    ORDER BY Forest_area_1990 DESC),
f_area_1990_2016 AS
    (SELECT *
    FROM area_2016
    JOIN area_1990
    USING (region,country_name))
SELECT country_name,region,Forest_area_1990,Forest_area_2016,ROUND((Forest_area_2016-Forest_area_1990)*100/Forest_area_1990::NUMERIC,2) AS Pct_Forest_Area_Change
FROM f_area_1990_2016
WHERE country_name <> 'World'
ORDER BY Pct_Forest_Area_Change
LIMIT 5;
```

/*NOTE:- with order by DESC we got country_name with highest Percentage_forest_area_change which was ICELAND*/

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

```
WITH
c_group AS
    (SELECT country_name,total_land_percentage,
    CASE WHEN total_land_percentage >= 75 THEN '75%-100%'
    WHEN total_land_percentage >= 50 THEN '50%-75%'
    WHEN total_land_percentage >= 25 THEN '25%-50%'
    ELSE '0%-25%' END AS Quartiles
    FROM forestation
    WHERE year = 2016 AND total_land_percentage IS NOT NULL AND country_name <> 'World')
SELECT Quartiles, COUNT(*) AS no_countries
FROM c_group
GROUP BY 1
ORDER BY Quartiles;
```

--d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.(REGION/COUNTRIES/PERCENTAGE DESIGNATED AS FOREST)

```
WITH
c_group AS
    (SELECT region,country_name,total_land_percentage,
    CASE WHEN total_land_percentage >= 75 THEN '75%-100%'
    WHEN total_land_percentage >= 50 THEN '50%-75%'
    WHEN total_land_percentage >= 25 THEN '25%-50%'
    ELSE '0%-25%' END AS Quartiles
    FROM forestation
    WHERE year = 2016 AND total_land_percentage IS NOT NULL AND country_name <> 'World')
SELECT country_name,region,ROUND(total_land_percentage::NUMERIC,2) AS Percentage_designated_forest
FROM c_group
WHERE total_land_percentage>=75
ORDER BY Quartiles;
```

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

```
SELECT COUNT(country_name)
FROM forestation
WHERE total_land_percentage >
    (SELECT total_land_percentage
    FROM forestation
    WHERE country_code = 'USA' AND year = 2016)
AND year = 2016;
```

/*In Latin America & the Caribbean and Sub-Saharan Africa, where forest area is dropping the most, the world lost 3.2% of its total forest area between 1990 and 2016, an area larger than Peru. This reduction impacts the entire world since there is a high percentage of forest area in these regions. However, countries like China and the United States have seen significant growth in their forest acreage, while comparable nations like Iceland have made significant efforts and seen success. Brazil exhibits a significant decline in forest acreage, while other countries like Russia have seen a slight increase. The last quarter only includes 9 countries (more than 75). The regions of Latin America & the Caribbean and Sub-Saharan Africa in particular should receive special consideration due to the countries there that have experienced the biggest reduction in forest area in the last quarter.