# Contents

# 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 sq-km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sq-km, a loss of 1324449 sq-km, 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 1279999.98 sq-km).

## 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 and the Caribbean, with 46.14%, and the region with the lowest relative forestation was Middle East and 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 and the Caribbean, with 51.08%, and the region with the lowest relative forestation was Middle East and 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 and Caribbean | 51.08 | 46.14 |
| Europe and Central Asia | 37.20 | 38.07 |
| North America | 35.66 | 36.02 |
| Sub-Saharan Africa | 30.65 | 28.72 |
| East Asia & Pacific | 25.57 | 26.29 |
| South Asia | 16.53 | 17.50 |
| 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 and Caribbean (dropped from 51.08% to 46.14%) and Sub-Saharan Africa (30.65% to 28.72%). 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 527,229.06 sq-km. 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 sq-km, 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 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 ($km^2$) |
|---|---|---|
| Brazil | Latin America and Caribbean | 541510 |
| Indonesia | East Asia and Pacific | 282192.98 |
| Myanmar | East Asia and 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 | 75.44 |
| Nigeria | Sub-Saharan Africa | 61.8 |
| Uganda | Sub-Saharan Africa | 59.12 |
| Mauritania | Sub-Saharan Africa | 46.74 |
| Honduras | Latin America and 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 and 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 | 84 |
| 25 – 30 | 70 |
| 50 – 75 | 37 |
| 75 - 100 | 9 |

The largest number of countries in 2016 were found in the first (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 | Pct Designated as Forest |
|---|---|---|
| Suriname | Latin America and Caribbean | 98.26 |
| Micronesia, Fed. Sts | East Asia and Pacific | 95.39 |
| Gabon | Sub-Saharan Africa | 90.98 |
| Seychelles | Sub-Saharan Africa | 90.04 |
| Palau | East Asia and Pacific | 88.41 |
| American Samoa | East Asia and Pacific | 87.50 |
| Guyana | Latin America and Caribbean | 83.90 |
| Lao PDR | East Asia and Pacific | 82.11 |
| Solomon Islands | East Asia and Pacific | 77.86 |

# 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?*

For the global situation there is 3.2 percent of decrease in the forest area, and it is even larger than the entire one country land (Peru). For the forestation the higher trends were observed in Latin America and the Caribbean, whilst the lowest in Middle East and North Africa. Surprisingly, Iceland shows highest increased in forest area in relative to its total land. However, the top country in the success story was China with greater forest area increased from 1990 to 2016.

Most of Sub-Saharan Africa regions are in great concern over the forest area decline. Among these regions, Nigeria shows top ranks both in percent decrease and absolute square mile decrease in forest area.

# 6. Appendix

```
/* 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 forest_area_sqkm
FROM forest_area
WHERE year = 1990
AND country_name = 'World'


SELECT *
FROM forest_area
WHERE country_name = 'World'
AND (year = 2016 OR 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 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? */

SELECT oldest_forest_area.forest_area_sqkm  - latest_forest_area.forest_area_sqkm
AS difference
FROM forest_area AS latest_forest_area
JOIN forest_area AS oldest_forest_area
  ON  (latest_forest_area.year = '2016' AND oldest_forest_area.year = '1990'
  AND latest_forest_area.country_name = 'World' AND
oldest_forest_area.country_name = 'World');

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

SELECT 100.0* (oldest_forest_area.forest_area_sqkm  -
latest_forest_area.forest_area_sqkm)/oldest_forest_area.forest_area_sqkm
AS percent
```

```
FROM forest_area AS latest_forest_area
JOIN forest_area AS oldest_forest_area
  ON  (latest_forest_area.year = '2016' AND oldest_forest_area.year = '1990'
  AND latest_forest_area.country_name = 'World' AND
oldest_forest_area.country_name = 'World');

 /* 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, (total_area_sq_mi * 2.59) AS total_area_sqkm
FROM land_area
WHERE year = 2016
AND (total_area_sq_mi * 2.59) < 1324449
ORDER BY total_area_sqkm DESC;

/* 2. REGIONAL OUTLOOK  */

DROP VIEW IF EXISTS region_to_forest;
/* 2. Making New Table
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, ....  */

CREATE VIEW region_to_forest AS
SELECT f.country_name, f.year, f.forest_area_sqkm,
l.total_area_sq_mi, r.region, r.income_group
FROM forest_area f, land_area l, regions r
WHERE (f.country_name = l.country_name
AND f.country_name = r.country_name);

SELECT * FROM region_to_forest;
/* 2.2. 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 Round(100.0*(rf.forest_area_sqkm /
  (rf.total_area_sq_mi * 2.59))::Numeric, 2) AS percentage
FROM region_to_forest rf
WHERE year = 2016
AND rf.country_name = 'World'
LIMIT 1;

SELECT region,
 Round(((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS
percent_forest
```

```sql
FROM region_to_forest
WHERE YEAR = 2016
GROUP BY region
ORDER BY percent_forest DESC

/* 2. 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 Round(100.0*(rf.forest_area_sqkm /
  (rf.total_area_sq_mi * 2.59))::Numeric, 2) AS percentage
FROM region_to_forest rf
WHERE year = 1990
AND rf.country_name = 'World'
LIMIT 1;

SELECT region,
 Round(((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS
percent_forest
FROM region_to_forest
WHERE YEAR = 1990
GROUP BY region
ORDER BY percent_forest DESC


/* 2. c. Based on the table you created, which regions of the world DECREASED in
forest area from 1990 to 2016?  */

SELECT ROUND(CAST((region_forest_1990/ region_area_1990) * 100 AS NUMERIC), 2)
  AS forest_percent_1990,
  ROUND(CAST((region_forest_2016 / region_area_2016) * 100 AS NUMERIC), 2)
  AS forest_percent_2016,
  region
FROM (SELECT SUM(a.forest_area_sqkm) region_forest_1990,
  SUM(a.total_area_sq_mi * 2.59) region_area_1990, a.region,
  SUM(b.forest_area_sqkm) region_forest_2016,
  SUM(b.total_area_sq_mi * 2.59)  region_area_2016
FROM  region_to_forest a, region_to_forest b
WHERE  a.year = '1990'
AND a.country_name != 'World'
AND b.year = '2016'
AND b.country_name != 'World'
AND a.region = b.region
GROUP  BY a.region) region_percent
ORDER  BY forest_percent_1990 DESC;
```

```sql
/* 3. COUNTRY-LEVEL DETAIL  */

/* 3. 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 T1 AS
 (SELECT country_name,
 forest_area_sqkm fa_1
 FROM region_to_forest
 WHERE YEAR = 1990
 GROUP BY country_name,
 forest_area_sqkm),
 T2 AS
 (SELECT country_name,
 (forest_area_sqkm) fa_2
 FROM region_to_forest
 WHERE YEAR = 2016
 GROUP BY country_name,
 forest_area_sqkm)
 SELECT f_prev.country_name,
 (f_prev.fa_1 - f_curr.fa_2) forest_change
FROM T1 f_prev
JOIN T2 f_curr ON f_prev.country_name = f_curr.country_name
ORDER BY forest_change
LIMIT 1

WITH T1 AS
 (SELECT country_name, region,
 SUM(forest_area_sqkm) forest_area_1
 FROM region_to_forest
 WHERE YEAR = 1990
 GROUP BY country_name,
 forest_area_sqkm, region),
 T2 AS
 (SELECT country_name,
 SUM(forest_area_sqkm) forest_area_2
 FROM region_to_forest
 WHERE YEAR = 2016
 GROUP BY country_name,
 forest_area_sqkm)
SELECT f.country_name, f.region,
 (f.forest_area_1 - t.forest_area_2) forest_change
FROM T1 f
JOIN T2 t ON f.country_name = t.country_name
WHERE f.forest_area_1 IS NOT NULL
```

```
 AND t.forest_area_2 IS NOT NULL
 AND f.country_name != 'World'
ORDER BY forest_change DESC
LIMIT 5


SELECT curr.country_name, r.region,
  curr.forest_area_sqkm - prev.forest_area_sqkm AS difference
FROM forest_area AS curr
JOIN forest_area AS prev
  ON  (curr.year = '2016' AND prev.year = '1990')
  AND curr.country_name = prev.country_name
 JOIN regions AS r
 ON curr.country_name = r.country_name
 WHERE curr.country_name != 'World'
ORDER BY difference
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?  */

WITH T1 AS
 (SELECT country_name,
 (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 fp_1
 FROM region_to_forest
 WHERE YEAR = 1990
 GROUP BY country_name,
 forest_area_sqkm),
 T2 AS
 (SELECT country_name,
 (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 fp_2
 FROM region_to_forest
 WHERE YEAR = 2016
 GROUP BY country_name,
 forest_area_sqkm)
 SELECT f_prev.country_name,
 Round((((f_prev.fp_1 -
f_curr.fp_2)/(f_prev.fp_1))*100)::Numeric, 2) percent_change
FROM T1 f_prev
JOIN T2 f_curr ON f_prev.country_name = f_curr.country_name
ORDER BY percent_change
LIMIT 5
```

```sql
SELECT curr.country_name,
  100.0*(curr.forest_area_sqkm - prev.forest_area_sqkm) /
  prev.forest_area_sqkm AS percentage
FROM forest_area AS curr
JOIN forest_area AS prev
  ON  (curr.year = '2016' AND prev.year = '1990')
  AND curr.country_name = prev.country_name
ORDER BY percentage;
/* c. If countries were grouped by percent forestation in quartiles, which group
had the most countries in it in 2016?  */
WITH T1 AS
 (SELECT country_name, year,
 (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 percent_forestation
 FROM region_to_forest
 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'
 WHEN percent_forestation>=25
 AND percent_forestation<50 THEN '25-50'
 WHEN percent_forestation>=50
 AND percent_forestation<75 THEN '50-75'
 ELSE '75-100'
 END AS quartiles
 FROM T1
 WHERE percent_forestation IS NOT NULL
 AND YEAR = 2016) sub

/* d. List all of the countries that were in the 4th quartile (percent forest >
75%) in 2016.  */
WITH T2 AS
 (WITH T1 AS
 (SELECT country_name,
 YEAR,
 (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 percent_forestation
 FROM region_to_forest forestation
 WHERE YEAR = 2016
 GROUP BY country_name,
 YEAR,
```

```
 forest_area_sqkm) SELECT Distinct(quartiles),
 count(country_name)Over(PARTITION BY quartiles),
 country_name,
 percent_forestation
 FROM
 (SELECT country_name,
 percent_forestation,
 CASE
 WHEN percent_forestation<=25 THEN '0-25'
 WHEN percent_forestation>25
 AND percent_forestation<=50 THEN '25-50'
 WHEN percent_forestation>50
 AND percent_forestation<=75 THEN '50-75'
 ELSE '75-100'
 END AS quartiles
 FROM T1
 WHERE percent_forestation IS NOT NULL
 AND YEAR = 2016) sub)
SELECT country_name,
 quartiles,
 Round(percent_forestation::Numeric, 2) percent_forestation
FROM T2
WHERE quartiles = '75-100'
ORDER BY percent_forestation DESC
```