# 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 **1279999.9891 sq.km.).**

## 2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was **31.37%**. The region with the highest relative forestation was **East Asia & Pacific**, with **50.09%,** and the region with the lowest relative forestation was **Middle East & North Africa**, with **3.19%** 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 **East Asia & Pacific**, with **47.38%,** and the region with the lowest relative forestation was **Middle East & North Africa**, with **2.69%** forestation.

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

| Region | 1990 Forest Percentage | 2016 Forest percentage |
|---|---|---|
| East Asia & Pacific | 47.38 | 50.09 |
| Latin America & Caribbean | 43.34 | 41.64 |
| Sub-Saharan Africa | 35.26 | 31.37 |
| World | 32.42 | 31.28 |
| North America | 29.95 | 30.20 |
| Europe & Central Asia | 26.33 | 28.30 |
| South Asia | 20.68 | 21.59 |
| Middle East & North Africa | 2.69 | 3.19 |

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 43.34% to 41.64%) and Sub-Saharan Africa (dropped from 35.26% to 31.37%). 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 31.28%.

# 3. **COUNTRY-LEVEL DETAIL**

## A. SUCCESS STORIES

There is one particularly bright spot in the data at the country level, **China**. This country increased in forest area from 1990 to 2016 by **527229.06 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 **79200 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 countries Amount Decrease in Forest Area by Country, 1990 & 2016:

| Country | Region | Forest Area difference |
|---|---|---|
| Brazil | Latin America & Caribbean | -541510 |
| Indonesia | East Asia & Pacific | -282193.98 |
| Myanmar | East Asia & Pacific | -107234.00 |
| Nigeria | Sub-Saharan Africa | -106506.00 |
| 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 countries in  Percent Decrease in Forest Area by Country, 1990 & 2016:

| **Country** | **Region** | **Percentage forest area change** |
|---|---|---|
| Togo | Sub-Saharan Africa | - 75.44 |
| Nigeria | Sub-Saharan Africa | - 61.79 |
| Uganda | Sub-Saharan Africa | -59.12 |
| Mauritania | Sub-Saharan Africa | -46.74 |
| 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 |
|---|---|
| 1 | 85 |
| 2 | 72 |
| 3 | 38 |
| 4 | 9 |

The largest number of countries in 2016 were found in the **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 | Percent Designated as Forest |
|---|---|---|
| Suriname | Latin America & Caribbean | 98.26 |
| Micronesia, Fed. Sts. | East Asia & Pacific | 91.88 |
| 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

- Total loss of forest area in these 26 years of period (1990 to 2016) is 3.21 % and almost the total area of Peru.
- Sub-Saharan African region has biggest loss of forest in terms of percentage where Latin America lost a significant portion of the forest area.
- Brazil who has a large part of Amazon Forest had lost a significant portion of it’s forest area during this period.
- Countries in Sub-Saharan zone like Togo, Nigeria, Uganda, Mauritania has the highest percentage of forest area loss during this period.

- Nigeria needs to adapt afforestation plan to save the country from different natural calamities.
- An inclusive approach should be taken to save the world from deforestation. For example, Approaching countries with higher income for funding could one step. Policy and scientific helps could be taken from those countries who has done extremely well in afforestation program during this period (e.g., China and USA) by balancing economy and climate change.
- Countries with higher income and better scientific facilities should help those countries which has higher forest area percentage but lower income (e.g. LAO PDR , Solomon Islands etc.)
- Brazil needs to have a massive afforestation plan to save the Amazon Forest and natural reserve in their countries since they have lost a significant amount of forest (541510 sq. km.) during these 26 years of period.
- Nigeria also needs an inclusive policy and afforestation plan since they also lost almost 62 % of their forest which is threat to their natural heritage and biodiversity.

## 5. APPENDIX: SQL queries used

```sql
/* Creating a view called "forestation" */
CREATE VIEW forestation
AS
    SELECT f.country_code country_code,
           f.country_name country,
           f.forest_area_sqkm forest_area,
           l.total_area_sq_mi * 2.59 total_land_area_sqkm,
           (f.forest_area_sqkm*100) / (l.total_area_sq_mi*2.59)
           forest_area_percentage ,
           f.year,
           r.region,
           r.income_group
    FROM forest_area f
    JOIN land_area l
        ON f.year = l.year AND f.country_code =l.country_code
    JOIN regions r
        ON f.country_code = r.country_code;

/* Total forest area in 1990*/

SELECT  fv.forest_area
        FROM forestation fv
            WHERE fv.year = 1990 AND fv.region = 'World';

/* Total forest area in 2016*/
SELECT  fv.forest_area
        FROM forestation fv
            WHERE fv.year = 2016 AND fv.region = 'World';

/* changes in the forest area (in sq km) of the world from 1990 to
2016? */

SELECT MIN ((SELECT  fv.forest_area FROM forestation fv WHERE
fv.year = 1990 AND fv.region = 'World') -
            (SELECT  fv.forest_area FROM forestation fv WHERE
            fv.year = 2016 AND fv.region = 'World')) change
    FROM forestation fv;

/* percent change in forest area of the world between 1990 and 2016 */

SELECT
        ROUND(MIN ((SELECT MIN ((SELECT  fv.forest_area FROM
        forestation fv WHERE fv.year = 1990 AND fv.region = 'World') -
            (SELECT  fv.forest_area FROM forestation fv WHERE
            fv.year = 2016 AND fv.region = 'World')) /
            (SELECT  fv.forest_area FROM forestation fv WHERE
            fv.year = 1990 AND fv.region = 'World'))) * 100 )
    FROM forestation fv;


/* comparison between forest area loss and area of the countries */
WITH fa_1990 AS (SELECT  fv.forest_area FROM forestation fv WHERE
fv.year = 1990 AND fv.region = 'World'),
                fa_change AS (SELECT MIN ((SELECT  fv.forest_area
                FROM forestation fv WHERE fv.year = 1990 AND
                fv.region = 'World') -
                                (SELECT  fv.forest_area FROM
                                forestation fv WHERE fv.year = 2016 AND
                                fv.region = 'World'))
```

```sql
                                    FROM forestation fv)
SELECT *
FROM forestation fv
WHERE fv.year = 2016
ORDER BY ABS(fv.total_land_area_sqkm- (SELECT * FROM fa_change))
        LIMIT 1 ;


/* percentage of total forest area in 2016 */
SELECT  fv.forest_area_percentage, fv.region
        FROM forestation fv
            WHERE fv.year = 2016 AND fv.region = 'World';


/* region had the HIGHEST percent forest in 2016, and which had the
LOWEST, to 2 decimal places */
SELECT  AVG(fv.forest_area_percentage)forest_prcnt_region, fv.region
        FROM forestation fv
            WHERE fv.year = 2016
            GROUP BY fv.region
            ORDER BY fv.forest_area_percentage DESC;


/* percent forest of the entire world in 1990 */
SELECT  fv.forest_area_percentage, fv.region
        FROM forestation fv
            WHERE fv.year = 1990 AND fv.region = 'World';


/*  Which region had the HIGHEST percent forest in 1990, and which
had the LOWEST, to 2 decimal places */
SELECT  AVG(fv.forest_area_percentage) forest_prcnt_region, fv.region
        FROM forestation fv
            WHERE fv.year = 1990 AND fv.region != 'World'
            GROUP BY fv.region
            ORDER BY forest_prcnt_region DESC;


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

WITH f_1990 AS (SELECT fv.country,  fv.country_code,fv.region,
fv.year year_1990, fv.forest_area forest_area_1990 FROM forestation
fv WHERE fv.year = 1990),
     f_2016 AS (SELECT fv.country, fv.country_code, fv.year
     year_2016, fv.forest_area forest_area_2016 FROM forestation fv
     WHERE fv.year = 2016)

SELECT f_2016.country, f_1990.region,
       f_2016.forest_area_2016 - f_1990.forest_area_1990
       forest_area_diff
FROM f_1990
JOIN f_2016
ON  f_1990.country_code = f_2016.country_code AND f_1990.country =
f_2016.country
WHERE (f_1990.forest_area_1990 IS NOT NULL) AND
(f_2016.forest_area_2016 IS NOT NULL) AND
        (f_1990.country != 'World')
        ORDER BY forest_area_diff
```

```sql
        LIMIT 5;


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

WITH f_1990 AS (SELECT fv.country,  fv.total_land_area_sqkm
total_area, fv.country_code,fv.region, fv.year year_1990,
fv.forest_area forest_area_1990 FROM forestation fv WHERE fv.year =
1990),
     f_2016 AS (SELECT fv.country, fv.country_code, fv.year
     year_2016, fv.forest_area forest_area_2016 FROM forestation fv
     WHERE fv.year = 2016)

SELECT f_2016.country, f_1990.region,
       (f_2016.forest_area_2016 - f_1990.forest_area_1990)
       /(f_1990.forest_area_1990*.01) forest_area_prcnt_diff,
       f_1990.total_area
FROM f_1990
JOIN f_2016
ON  f_1990.country_code = f_2016.country_code AND f_1990.country =
f_2016.country
WHERE (f_1990.forest_area_1990 IS NOT NULL) AND
(f_2016.forest_area_2016 IS NOT NULL) AND
        (f_1990.country != 'World')
        ORDER BY forest_area_prcnt_diff
        LIMIT 5;


/* If countries were grouped by percent forestation in quartiles,
which group had the most countries in it in 2016?*/
SELECT DISTINCT (forest_quartiles), COUNT (country) OVER (PARTITION
BY forest_quartiles)
FROM (SELECT country , CASE WHEN forest_area_percentage <= 25 THEN 1
                       WHEN forest_area_percentage > 25 AND
                             forest_area_percentage <= 50 THEN 2
                       WHEN forest_area_percentage > 50 AND
                             forest_area_percentage <= 75 THEN 3
                       ELSE 4 END AS forest_quartiles
    FROM forestation
    WHERE (year = 2016) AND (forest_area_percentage IS NOT NULL) AND
    (region != 'World') ) q1;


/* List all of the countries that were in the 4th quartile (percent
forest > 75%) in 2016.*/
SELECT country, region, forest_area_percentage
    FROM forestation
    WHERE (year = 2016) AND (forest_area_percentage > 75) AND
    (region != 'World')
    ORDER BY forest_area_percentage DESC;


/* How many countries had a percent forestation higher than the
United States in 2016*/
SELECT COUNT(*) num_countries
FROM(SELECT forest_area_percentage not_USA
```

```
140         FROM forestation
141         WHERE (year = 2016) AND (forest_area_percentage IS NOT NULL) AND
142                 (country not LIKE 'United States')) u1
143         WHERE (SELECT forest_area_percentage USA
144                 FROM forestation
145                 WHERE year = 2016 AND (forest_area_percentage IS NOT
                    NULL) AND
146                  (country LIKE 'United States')) < u1.not_USA
```