

# 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 41,282,694.9 km<sup>2</sup> in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 km<sup>2</sup> a loss of 1,324,449.00 km<sup>2</sup> or 3.20824258980244%

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 1,279,999.99 km<sup>2</sup>).

## 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
World	32.42%	31.38%
Latin America & Caribbean	51.03	46.16%
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 Middle East & North 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 527,229.06 km<sup>2</sup>. 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 79,200.00 km<sup>2</sup>, 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: being Brazil, Indonesia and Myanmar.

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

Country	Region	Absolute Forest Area Change
Brazil	Latin America & Caribbean	541,510.00
Indonesia	East Asia & Pacific	282,193.98
Myanmar	East Asia & Pacific	107,234.00
Nigeria	Sub-Saharan Africa	106,506.00
Tanzania	Sub-Saharan Africa	102,320.00

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	59.13%
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, 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 1<sup>st</sup> (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	Sub-Saharan Africa	98.26%
Micronesia, Fed. Sts.	Sub-Saharan Africa	91.86%
Gabon	Sub-Saharan Africa	90.04%
Seychelles	Sub-Saharan Africa	88.41%
Palau	Sub-Saharan Africa	87.61%
American Samoa	Sub-Saharan Africa	87.50%
Guyana	Sub-Saharan Africa	83.90%
Lao PDR	Sub-Saharan Africa	82.11%
Solomon Islands	Sub-Saharan Africa	77.86%

## 5. RECOMMENDATIONS

Although there are countries whose forest areas are increasing, we have lost a little bit over the whole area land of Peru in forest area between 1990 and 2016 around the world. I also learned that while the countries in the Sub-Saharan region have the largest land area designated as forest, they have suffered the largest decrease between 1990 and 2016.

We should focus on more on our largest concerns. The countries in the Sub-Saharan region. We should also find out what is causing the loss forest area and devise a plan to either offset the rate of deforestation or completely stop it. What are China, United States and Iceland doing that we can also apply to warmer climates? Finally, we should keep in mind that that deforestation, climate (among other variables) in each country is different. Therefore, while each region can use the “plan” as a template, they should be able to tailor it to their needs.

## 6. APPENDIX

### --Create forestation table

```
DROP VIEW IF EXISTS forestation;
```

```
CREATE VIEW forestation
```

```
AS
```

```
    SELECT f.country_code          AS
           country_code,
           f.country_name          AS
           country_name,
           f.year                  AS YEAR
```

```
,
```

```
    f.forest_area_sqkm           AS
```

```
        forest_area_sqkm,
```

```
    l.total_area_sq_mi           AS
```

```
        total_area_sq_mi,
```

```
    r.region                     AS regi
```

```
on,
```

```
    r.income_group              AS
```

```
        income_group,
```

```
    ( f.forest_area_sqkm / ( l.total_area_sq_mi * 2.59 ) ) * 100 AS
```

```
        percent_forest
```

```
FROM forest_area f,
```

```
land_area l,
```

```
regions r
```

```
WHERE f.country_code = l.country_code
```

```
AND f.year = l.year
```

```
AND l.country_code = r.country_code;
```

## 1. GLOBAL SITUATION

```
--
```

```
SELECT Sum(forest_area_sqkm) AS total_forest_area
```

```
FROM forestation
```

```
WHERE year = 1990
```

```
AND country_name = 'World'
```

```
--
```

```
SELECT Sum(forest_area_sqkm) AS total_forest_area
```

```
FROM forestation
```

```
WHERE year = 2016
```

```
AND country_name = 'World';
```

```

--
SELECT (SELECT Sum(forest_area_sqkm) AS total_forest_area
        FROM   forestation
        WHERE  year = 2016
            AND country_name = 'World') - (SELECT
        Sum(forest_area_sqkm) AS total_forest_area
        FROM   forestation
        WHERE  year = 1990
            AND country_name = 'World')
AS
change_forest_area

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

--
SELECT country_name,
        Round(( total_area_sq_mi * 2.59 ) :: NUMERIC, 2) AS total_area_sq_km
FROM   forestation
WHERE  year = '2016'
        AND ( total_area_sq_mi * 2.59 ) < 1324449
--132449 being total loss
ORDER BY total_area_sq_km DESC
LIMIT 1;

```

## 2. REGIONAL OUTLOOK

```
SELECT country_name,
       Round(( ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) ) * 100 ) ::
             NUMERIC, 2
             ) AS percent_forest
FROM   forestation
WHERE  year = 2016
AND    country_name = 'World';

--

SELECT region,
       Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59) ) * 100
             )
             ::
             NUMERIC, 2) AS total_percent_forest,
       year
FROM   forestation
WHERE  year = 2016
GROUP BY 1,
         3
ORDER BY 2 DESC;

--

SELECT region,
       Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59) ) * 100
             )
             ::
             NUMERIC, 2) AS total_percent_forest,
       year
FROM   forestation
WHERE  year = 2016
GROUP BY 1,
         3
ORDER BY 2;

--

SELECT country_name,
       Round(( ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) ) * 100 ) ::
             NUMERIC, 2
             ) AS percent_forest
FROM   forestation
WHERE  year = 1990
AND    country_name = 'World';
```



```
--
SELECT region,
       Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59) ) * 100
              ::
              NUMERIC, 2) AS total_percent_forest,
       year
FROM   forestation
WHERE  year = 1990
GROUP BY 1,
         3
ORDER BY 2 DESC;
```

```
--
SELECT region,
       Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59) ) * 100
              ::
              NUMERIC, 2) AS total_percent_forest,
       year
FROM   forestation
WHERE  year = 1990
GROUP BY 1,
         3
ORDER BY 2;
```

### 3. COUNTRY-LEVEL DETAIL

#### Success Story I

```
SELECT fa1.country_name,
       fa1.forest_area_sqkm
S
       forest_area_1990,
       fa2.forest_area_sqkm
S
       forest_area_2016,
       Round(( fa2.forest_area_sqkm - fa1.forest_area_sqkm ) :: NUMERIC, 2) A
S
       difference
FROM   forest_area fa1
JOIN   forest_area fa2
       ON fa1.country_name = fa2.country_name
```

```

WHERE  fa1.year = 1990
      AND fa2.year = 2016
      AND fa1.forest_area_sqkm < fa2.forest_area_sqkm
ORDER  BY 4 DESC
LIMIT  2;

```

## Success Story II

```

WITH t1 AS
(
    SELECT  country_name,
            (Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100 pe
rcent_forest_1990
    FROM    forestation
    WHERE   year = 1990
    GROUP BY 1,
            forest_area_sqkm), t2 AS
(
    SELECT  country_name,
            (Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100 pe
rcent_forest_2016
    FROM    forestation
    WHERE   year = 2016
    GROUP BY 1,
            forest_area_sqkm)
SELECT  f.country_name,
        Round((((f.percent_forest_1990 - t.percent_forest_2016)/(f.percent_f
orest_1990))*100)::numeric, 2) percent_change
FROM    t1 f
JOIN    t2 t
ON      f.country_name = t.country_name
ORDER BY percent_change limit 1;

```

## LARGEST CONCERNS KM2

```

SELECT  f1.country_name,
        f1.region,
        Round(( f1.forest_area_sqkm - f2.forest_area_sqkm ) :: NUMERIC, 2) AS
forest_area_change_sqkm
FROM    forestation AS f1
JOIN    forestation AS f2
        ON ( f1.year = '2016'
            AND f2.year = '1990' )
        AND f1.country_code = f2.country_code
WHERE   f1.country_name != 'World'
ORDER  BY 3
LIMIT  5;

```

LARGEST CONCERNS %

```
SELECT f1.country_name,
       f1.region,
Round(
(
( f1.forest_area_sqkm - f2.forest_area_sqkm ) * 100 / f2.forest_area_sqkm ) :
:
    NUMERIC, 2) AS pct_forest_area_change
FROM   forestation AS f1
JOIN   forestation AS f2
    ON ( f1.year = '2016'
        AND f2.year = '1990' )
    AND f1.country_code = f2.country_code
WHERE  f1.country_name != 'World'
ORDER BY 3
LIMIT 5;
```

### 3. QUARTILES

```
WITH t1
    AS (SELECT country_name,
               year,
               ( Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2.59) ) * 10
0
               AS
               percent_forestation
    FROM   forestation
    WHERE  year = 2016
        AND country_name != 'World'
    GROUP BY 1,
             2,
             forest_area_sqkm)
SELECT DISTINCT( quartiles ),
               Count(country_name)
               OVER(
                   partition BY quartiles) AS number_of_countries
FROM   (SELECT country_name,
               CASE
                   WHEN percent_forestation < 25 THEN '1. 0%-25%'
                   WHEN percent_forestation > 25
                       AND percent_forestation < 50 THEN '2. 25%-50%'

```

```

        WHEN percent_forestation > 50
            AND percent_forestation < 75 THEN '3. 50%-75%'
        ELSE '4. 75%-100%'
    END AS quartiles
FROM t1
WHERE percent_forestation IS NOT NULL
AND year = 2016) quart_2016;

```

## TOP QUARTILES

```

WITH t2 AS (WITH t1 AS
(
    SELECT country_name,
           year,
           (Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100 pe
percent_forestation
    FROM forestation
    WHERE year = 2016
    AND country_name!='World'
    GROUP BY country_name,
            year,
            forest_area_sqkm)
SELECT DISTINCT(quartiles),
               Count (country_name) OVER (partition BY quartiles) AS number_
of_countries,
               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) quart_2016)
SELECT country_name,
       quartiles,
       Round(percent_forestation::numeric, 2) percent_forestation

```

```

FROM      t2
WHERE      quartiles = '75%-100%'
ORDER BY  percent_forestation DESC limit 3;

```

How many countries had a percent forestation higher than the United States in 2016? (I don't think this question is part of the report however, it's one of the Udacity questions.)

```

WITH tab1
  AS (SELECT country_name,
             year,
             Round(( ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) ) *
100
                    ) ::
                    NUMERIC, 2
             ) AS percent_forest
  FROM   forestation
 WHERE  1 = 1
        AND year = 2016
        ORDER BY percent_forest)
SELECT Count(tab1.country_name)
FROM   tab1
WHERE  tab1.percent_forest > (SELECT tab1.percent_forest
                             FROM   tab1
                             WHERE  tab1.country_name = 'United States');

```