

# 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.

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## 1. GLOBAL SITUATION

According to the World Bank, the total forest area of the world was **41,282,694.90** [km<sup>2</sup>] in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.90** [km<sup>2</sup>], a loss of **1,324,449.00** [km<sup>2</sup>], 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 **1,280,000.00** [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	2016 Forest Percentage	1990 Forest Percentage	$\Delta$ Forest Percentage	Pct Forest Area Change
Latin America & Caribbean	51.03	46.16	-4.87	-9.68
Sub-Saharan Africa	32.19	27.56	-4.63	-10.16
World	32.42	31.38	-1.04	-3.21
Middle East & North Africa	1.78	2.07	0.29	16.48
North America	35.65	36.04	0.39	1.02
East Asia & Pacific	25.77	26.36	0.59	2.27
Europe & Central Asia	37.27	38.06	0.79	2.42
South Asia	16.51	17.51	1.00	5.84

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%**). 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 **527229.10** [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 **79200.00** [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: **Brazil**, **Indonesia**, and **Myanmar**.

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

Country	Region	Absolute Forest Area Change [km <sup>2</sup> ]
Brazil	Latin America & Caribbean	541,510
Indonesia	East Asia & Pacific	282,194
Myanmar	East Asia & Pacific	107,234
Nigeria	Sub-Saharan Africa	106,506
Tanzania	Sub-Saharan Africa	102,320

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 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 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 **1<sup>st</sup> (first)** quartile.

There were **9 (nine)** 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 these 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	87.5
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

## 4. RECOMMENDATIONS

- The discussed analysis performed by SQL based advanced tabular analysis provides a comprehensive review on the countries and regions around the world where forests areas and relative percentages have been shrinking.  
With high emphasizes, we recommend further following up and investigation on countries categorized with moderate to high risk of deforestation.  
As discussed in section. B, we recommend Investigating the region of **Sub-Saharan Africa** where severe cases of deforestation had been observed in countries like **Togo, Nigeria and Uganda**.
- Furthermore, our analysis provide a clear insight on countries and regions with the most significant forest area, both in terms of amount and percent of total area, like **China**, the United states as well as the **Top Quartile countries** which are considered role models with duties of leading international initiatives, and managing worldwide communications to achieve the largest impact encouraging and hopefully financially supporting countries and institutions which are developing forestation plans.
- Since the **United States** is considered a successful forestation model with the second largest increase in forest area from 1990 to 2016, right after China. I recommend further follow up on the 94 countries which had, in 2016, a forestation percent higher than the United States. Focusing on the countries with lowest forestation percent, such as **Andorra, Eswatini, Croatia, Czech Republic and Portugal** would be provide enriching data that enables developing a remedial methodology utilizing Artificial Intelligence based algorithms. A methodology which would be replicated in countries categorized in high risk where it is essential to increase their forestation areas significantly.
- **Nigeria** is clearly categorized as a country in high risk being within the top 5 countries suffering from high amount/percent decrease in forest area between 1990 and 2016. It is highly recommended to follow up and focus strongly on this country since it is necessary to help it stop the decline and hopefully spearhead remedial efforts.

## 5. APPENDIX: SQL Queries Used

- Creating a View table called “forestation”:

```
DROP VIEW IF EXISTS forestation;
CREATE OR REPLACE VIEW forestation AS
SELECT fa.*,
la.total_area_sq_mi*2.59 AS total_area_sqkm,
r.region, r.income_group,
ROUND(((fa.forest_area_sqkm/(la.total_area_sq_mi*2.59))*100)::numeric,2) AS
forest_area_percent
FROM forest_area fa
JOIN land_area la
ON fa.country_code = la.country_code AND fa.year = la.year
JOIN regions r
ON fa.country_code = r.country_code
AND fa.forest_area_sqkm IS NOT NULL
AND la.total_area_sq_mi IS NOT NULL;
SELECT *
FROM forestation;
```

```
DROP VIEW IF EXISTS forestation;
CREATE OR REPLACE VIEW forestation AS
SELECT fa.*,
la.total_area_sq_mi*2.59 AS total_area_sqkm,
r.region,
r.income_group,
ROUND(((fa.forest_area_sqkm/(la.total_area_sq_mi*2.59))*100)::numeric,2)
AS forest_area_percent
FROM forest_area fa
JOIN land_area la
ON fa.country_code = la.country_code AND fa.year = la.year
JOIN regions r
ON fa.country_code = r.country_code
AND fa.forest_area_sqkm IS NOT NULL
AND la.total_area_sq_mi IS NOT NULL;
SELECT *
FROM forestation;
```

- Simply copy and paste the SQL scripts including the comments within /\*\*/.

- Part 1 - Global Situation:

**/\*The following SELECT query performed alone\*/**

```
SELECT year, forest_area_sqkm
FROM forestation
WHERE year IN (1990,2016)
      AND region = 'World';
```

**/\*The following WITH query will be used with 2 different SELECT queries\*/**

```
WITH year2016 AS (
    SELECT forest_area_sqkm
    FROM forestation
    WHERE year = 2016 AND region = 'World'),
year1990 AS (
    SELECT forest_area_sqkm
    FROM forestation
    WHERE year = 1990 AND region = 'World')
```

**/\*1<sup>st</sup> SELECT query\*/**

```
SELECT
    (SELECT forest_area_sqkm FROM year1990) -
    (SELECT forest_area_sqkm FROM year2016)
    AS change_sqkm,
    ROUND (((SELECT forest_area_sqkm FROM year1990) -
    (SELECT forest_area_sqkm FROM year2016))*100 /
    (SELECT forest_area_sqkm FROM year1990))::numeric,2)
    AS change_prcnt;
```

**/\*2nd SELECT query\*/**

```
SELECT country_name,
    ROUND (total_area_sqkm::numeric,2) AS total_area_sqkm
FROM forestation
ORDER BY ABS (total_area_sqkm -
    ((SELECT forest_area_sqkm FROM year1990) -
    (SELECT forest_area_sqkm FROM year2016)))
LIMIT 1;
```

- Part 2 - Regional Outlook:

**/\*The following WITH query will be used with one SELECT query but with 2 different order rules \*/**

With forest\_precentage\_1990 AS (

```
SELECT region,
      SUM (forest_area_sqkm) AS tot_frst_1990,
      ROUND ((SUM(forest_area_sqkm)*100 /
              SUM(total_area_sqkm))::numeric,2)
      AS frst_prct_1990
```

```
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY tot_frst_1990 ),
```

forest\_precentage\_2016 AS (

```
SELECT region,
      SUM (forest_area_sqkm) AS tot_frst_2016,
      ROUND ((SUM(forest_area_sqkm)*100 /
              SUM(total_area_sqkm))::numeric,2)
      AS frst_prct_2016
```

```
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY tot_frst_2016 ),
```

joined\_1990\_2016 AS (

```
SELECT forest1990.region AS region_name,
      frst_prct_1990,
      frst_prct_2016,
      ROUND ((frst_prct_2016-frst_prct_1990)::numeric,2) AS prct_delta,
      ROUND (((tot_frst_2016) - (tot_frst_1990))*100 /
              (tot_frst_1990))::numeric,2)
      AS prct_change
```

```
FROM forest_precentage_1990 forest1990
JOIN forest_precentage_2016 forest2016
ON forest1990.region=forest2016.region
GROUP BY region_name, frst_prct_1990,
      frst_prct_2016, prct_delta, prct_change )
```

**/\*The SELECT query\*/**

```
SELECT *
FROM joined_1990_2016
```

**/\*1<sup>st</sup> Order rule\*/**

```
ORDER BY frst_prct_2016, frst_prct_1990;
```

**/\*2<sup>nd</sup> Order rule\*/**

```
ORDER BY prct_delta, prct_change;
```



- Part 3 - Country-Level Detail:

**/\*The following WITH query will be used with 4 different SELECT queries\*/**

```

With forest_amount_1990 AS (
    SELECT country_name, region,
           forest_area_sqkm AS forest_amt_1990
    FROM forestation
    WHERE year = 1990
           AND country_name NOT LIKE 'World'
    GROUP BY country_name,
           forest_amt_1990, region ),
forest_amount_2016 AS (
    SELECT country_name, region,
           forest_area_sqkm AS forest_amt_2016,
           ROUND ((forest_area_sqkm*100 /
                   total_area_sqkm)::numeric,2)
           AS frst_prnt
    FROM forestation
    WHERE year = 2016
           AND country_name NOT LIKE 'World'
    GROUP BY country_name,
           forest_amt_2016, region, frst_prnt ),
joined_1990_2016 AS (
    Select forest1990.country_name, forest1990.region,
           forest_amt_1990, forest_amt_2016
    FROM forest_amount_1990 forest1990
         JOIN forest_amount_2016 forest2016
         ON forest1990.country_name=forest2016.country_name
           AND forest1990.region=forest2016.region ),
quartiles_table_2016 AS (
    SELECT country_name, frst_prnt, region,
    CASE
        WHEN frst_prnt > 75 THEN 4
        WHEN frst_prnt > 50 THEN 3
        WHEN frst_prnt > 25 THEN 2
        ELSE 1 END AS quartile
    FROM forest_amount_2016
    GROUP BY country_name, region, frst_prnt, quartile)

```

**/\*1<sup>st</sup> SELECT query\*/**

```
SELECT country_name, region,  
((forest_amt_2016) - (forest_amt_1990)) AS amt_change,  
ROUND (((forest_amt_2016) - (forest_amt_1990))*100 /  
      (forest_amt_1990))::numeric,2)  
      AS prcnt_change  
FROM joined_1990_2016  
ORDER BY amt_change, prcnt_change  
LIMIT 5;
```

**/\*2nd SELECT query\*/**

```
SELECT quartile,  
      COUNT(country_name) AS country_count  
FROM quartiles_table_2016  
GROUP BY quartile  
ORDER BY country_count DESC;
```

**/\*3rd SELECT query\*/**

```
SELECT country_name, region, frst_prct  
FROM quartiles_table_2016  
WHERE quartile = 4  
GROUP BY region, country_name, frst_prct  
ORDER BY frst_prct DESC;
```

**/\*4th SELECT query\*/**

```
SELECT COUNT(country_name) AS country_count  
FROM quartiles_table_2016  
WHERE frst_prct > (  
      SELECT frst_prct  
      FROM quartiles_table_2016  
      WHERE country_name = 'United States');
```