# 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 41,282,695 sq km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,246 sq km a loss of 1,324,449 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 1,280,000 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 & 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 |
|---|---|---|
| Latin America & Caribbean | 30.67 | 46.16 |
| Europe & Central Asia | 51.03 | 38.04 |
| North America | 35.65 | 36.04 |
| Sub-Saharan Africa | 30.67 | 28.79 |
| East Asia & Pacific | 25.78 | 26.36 |
| South Asia | 16.51 | 17.51 |
| 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 Sub-Saharan Africa (dropped from 30.67% to 28.79%) and Latin America & Caribbean (51.03 % to 46.16 %). 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 527229.06. 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, much lower than the figure for Iceland.

China and the 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 |
|---------|--------|------------------------------|
| Brazil | Latin America & Caribbean | 541510.00 |
| Indonesia | East Asia & Pacific | 282194.98 |
| Myanmar | East Asia & Pacific | 107234.00 |
| Nigeria | Sub-Saharan Africa | 106506.00 |
| Tanzania | Sub-Saharan Africa | 102320.00 |

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 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 1st (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 |
|---|---|---|
| Surinam | 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 | 87.50 |
|---|---|---|
| Guyana | Latin America & Caribbean | 83.90 |
| Lao PDR | East Asia & Pacific | 82.11 |
| Solomon Islands | East Asia & Pacific | 77.86 |

94 countries had higher percentages of forestation than the United States of America in 2016.

# 5. RECOMMENDATIONS

*Write out a set of recommendations as an analyst on the ForestQuery team.*
- *What have you learned from the World Bank data?*
  The most affected regions appear to be in Sub-Saharan Africa. 4 of the 5 top biggest descreases in forest area are all in this region. This will have large forest regions so it is disappointing that such a region is losing such big amounts of forest
- *Which countries should we focus on over others?*
  Brazil has seen the biggest fall in forest area between 1990 and 2016 since this country has the world's biggest forest this is an obvious concern. China, one of the world's biggest countries has actually seen a forest increase from 1990 to 2016, if this is true then attention should be paid into how China achieved this so lessons could be learned by the other countries.

# APPENDIX: SQL queries used

## 1.Global Situation

**--create forestation view**

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

ON r.country_code = l.country_code

**--1a, 1b What was the total forest area (in sq km) of the world in 1990 and 2016**

```
SELECT country_name,year,total_area_sq_mi,
       round(forest_area_sqkm) AS forest_area_sq_km FROM forestation
WHERE country_name = 'World' AND year in (1990,2016)
```

**--1c and d What was the change (in sq km) in the forest area of the world FROM 1990 to 2016?**

```
SELECT   (a.pct_forest_land - b.pct_forest_land ) AS percent_difference,
         (a.forest_area_sqkm - b.forest_area_sqkm ) AS forest_difference
FROM     forestation a,forestation b
WHERE    a.year=1990 AND b.year=2016 AND a.country_name='World'  AND
         a.country_name=b.country_name
```

**--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 square_km
FROM forestation
WHERE year='2016' AND total_area_sq_mi * 2.59 < 1324449
ORDER BY 2 DESC
LIMIT 1
```

## 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**.

```
CREATE TABLE regional_outlook AS
(
       SELECT f.year, r.region,
       ROUND(CAST((SUM(f.forest_area_sqkm)*100)/(sum(l.total_area_sq_mi*2.59))
       AS NUMERIC),2) AS forest_area_percentage
       FROM forest_area f
       JOIN land_area l
       ON f.country_code=l.country_code AND f.year=l.year
       JOIN regions r
```

```
            ON r.country_code=f.country_code
            WHERE f.year IN(1990, 2016)
            Group by 2,1
);
```

**--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 * FROM regional_outlook
WHERE year = 2016
ORDER BY forest_area_percentage 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 * FROM regional_outlook
WHERE year = 1990
ORDER BY forest_area_percentage DESC
```

**--c Based ON the table you created, which regions of the world DECREASED in**
**forest -- area FROM 1990 to 2016?**

```
SELECT region,(a.forest_area_sqkm - b.forest_area_sqkm ) AS forest_difference
FROM    regional_outlook a,regional_outlook b
WHERE      a.year=1990 AND b.year=2016
```

**--this shows all the changes per region per year**

```
SELECT * FROM regional_outlook
ORDER BY region, year
```

**--this gives the percent change FROM 1990 to 2016**

```
SELECT a.region,
        (b.forest_area_percentage - a.forest_area_percentage) AS pct_change
FROM regional_outlook a
JOIN  regional_outlook b
```

ON a.region = b.region
WHERE a.year = 1990 AND b.year = 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?**

```
SELECT a.country_name,a.region,
          (b.forest_area_sqkm - a.forest_area_sqkm) AS  forest_area_change
FROM forestation a
JOIN forestation b
ON a.country_name = b.country_name
WHERE a.year = 1990 AND b.year = 2016 AND a.country_name <> 'World'
ORDER BY forest_area_change
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?**

```
SELECT   a.country_name, b.region,
          ROUND(CAST (( (b.forest_area_sqkm - a.forest_area_sqkm)
*100/a.forest_area_sqkm) AS NUMERIC),2) AS percent_change
FROM forestation a
JOIN forestation b
ON a.country_name=b.country_name AND a.country_name <> 'World'
WHERE a.year=1990 AND b.year=2016
ORDER BY percent_change
LIMIT 5
```

**--SUCCESS STORIES**
**--iceland**
```
SELECT a.country_name, a.pct_forest_land AS Forest_area_1990,
      b.pct_forest_land AS Forest_area_2016,
      abs(a.pct_forest_land  - b.pct_forest_land)/a.pct_forest_land*100 AS increase
FROM forestation a
```

JOIN forestation b ON a.country_name = b.country_name WHERE a.year = 1990 AND b.year = 2016
AND a.pct_forest_land < b.pct_forest_land ORDER BY increase desc ;

**--China & USA**
SELECT a.country_name,a.region,
        round(cast((a.forest_area_sqkm - b.forest_area_sqkm)AS numeric),2) AS forest_area_change
FROM forestation a
JOIN forestation b
ON a.country_name = b.country_name
WHERE a.year = 1990 AND b.year = 2016 AND a.country_name <> 'World'
ORDER BY forest_area_change
LIMIT 5

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

WITH table1 AS
(       SELECT * FROM forestation WHERE year = 2016 AND region <> 'World'
        AND pct_forest_land is not null
),
table2 AS
(
        SELECT *,
        Case When pct_forest_land >75 THEN 'Quartile4'
        When pct_forest_land >50 AND pct_forest_land <=75 THEN 'Quartile3'
        When pct_forest_land >25 AND pct_forest_land <=50 THEN 'Quartile2'
        ELSE 'Quartile1'
        END AS quartiles
        FROM table1
)
SELECT quartiles, count(*) AS quartiles_group FROM table2
group by 1
ORDER BY 1

**--d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.**

```sql
SELECT DISTINCT(quartiles), COUNT(country_name)
OVER (PARTITION BY quartiles)
FROM
        (SELECT country_name,
                CASE WHEN pct_forest_land > 75 THEN '75%-100%'
                WHEN pct_forest_land >50 AND pct_forest_land <=75 THEN '50%-75%'
                WHEN pct_forest_land >25 AND pct_forest_land <=50 THEN '25%-75%'
                ELSE '0-25%'
                END AS quartiles
                FROM forestation
                WHERE pct_forest_land IS NOT NULL AND year = 2016
                )sub;
```

**--top quartile countries**

```sql
SELECT country_name, region, round(pct_forest_land::numeric,2)AS pct_as_forest
FROM forestation
WHERE pct_forest_land > 75 AND pct_forest_land IS NOT NULL AND year = 2016
ORDER BY 3 DESC;
```

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

```sql
SELECT COUNT(country_name)
FROM forestation
WHERE year = 2016 AND pct_forest_land >
   (SELECT pct_forest_land
        FROM forestation
        WHERE country_name = 'United States' AND year = 2016
        );
```