# Report for ForestQuery into Global Deforestation, 1990 to 2016

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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 **41,282,694.90km$^2$** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.90km$^2$**, a loss of **1,324,449km$^2$**, 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 **1,279,999.99$^2$**)

## 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 | 51.03% | 46.16% |
| Europe & Central Asia | 37.28% | 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 **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. 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 km$^2$** 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 in sq km |
|---|---|---|
| Brazil | Latin America & Caribbean | 541510.00 |
| Indonesia | East Asia & Pacific | 282193.98 |
| Myanmar | | 107234.00 |
| Nigeria | Sub-Saharan Africa | 106506.00 |
| Tanzania | | 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 | | 61.80 |
| Uganda | | 59.13 |
| Mauritania | | 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** 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 |
|---|---|
| 0 – 25% | 85 |
| 25 - 50% | 72 |
| 50 - 75% | 38 |
| 75 - 100% | 9 |

The largest number of countries in 2016 were found in the **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 |
|---|---|---|
| Solomon Islands | East Asia & Pacific | 77.86 |
| Lao PDR | | 82.11 |
| Guyana | Latin America & Caribbean | 83.90 |
| American Samoa | Sub-Saharan Africa | 87.50 |
| Palau | East Asia & Pacific | 87.61 |
| Seychelles | Sub-Saharan Africa | 88.41 |
| Gabon | | 90.04 |
| Micronesia, Fed. Sts | East Asia & Pacific | 91.86 |
| Suriname | Latin America & Caribbean | 98.26 |

# 4. RECOMMENDATIONS

*Write out a set of recommendations as an analyst on the ForestQuery team.*

- *What have you learned from the World Bank data?*

The data shows that the forests are disappearing. The analysis showed a reduction in the world's forest area between 1990 - 2016. The regions of Sub-Saharan Africa were the most impacted.
Table 3.3, shows that 85 countries are in the 0 - 25% forestation group, and then another 72 countries are in the second 25 - 50% group.

- *Which countries should we focus on over others?*

My recommendation is to focus on the countries that have the most reduction in the forest area (Table 3.1).
Top countries that should be very careful are Brazil, Indonesia, Myanmar, Nigeria and Tanzania.

# Appendix – SQL Code:

Created “forestation” View:

```
CREATE VIEW Forestation AS
SELECT r.country_name,
 f.year,
 r.income_group,
 r.region,
 l.total_area_sq_mi,
 f.forest_area_sqkm,
 ((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100)
percentage_forest
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
GROUP BY r.country_name,
 f.year,
 r.income_group,
 r.region,
 l.total_area_sq_mi,
 f.forest_area_sqkm
```

## Global situation

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 SUM(forest_area_sqkm) total_forest_area
FROM Forestation
WHERE YEAR = 1990
 AND country_name = 'World'
```

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 SUM(forest_area_sqkm) total_forest_area
FROM forestation
WHERE YEAR = 2016
 AND country_name = 'World'

```

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
SELECT (
 (SELECT SUM(forest_area_sqkm) total_forest_area
 FROM Forestation
 WHERE YEAR = 1990
 AND country_name = 'World') -
 (SELECT SUM(forest_area_sqkm) total_forest_area
 FROM forestation
 WHERE YEAR = 2016
 AND country_name = 'World')) AS Difference
FROM Forestation
LIMIT 1
```

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

```sql
SELECT (((
 (SELECT SUM(forest_area_sqkm) total_forest_area
 FROM Forestation
 WHERE YEAR = 1990
 AND country_name = 'World') -
 (SELECT SUM(forest_area_sqkm) total_forest_area
 FROM forestation
 WHERE YEAR = 2016
 AND country_name = 'World')) / (
 (SELECT SUM(forest_area_sqkm) total_forest_area
 FROM forestation
WHERE YEAR = 1990
 AND country_name = 'World'))) *100) AS Percent_decrease
FROM forestation
LIMIT 1
```

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?

```sql
WITH tb1 AS
    (SELECT MAX(forest_area_sqkm) - MIN(forest_area_sqkm) AS deforest
      FROM forestation),

tb2 AS
    (SELECT *,
            total_area_sq_mi * 2.59 AS total_area_sq_km
     FROM land_area FULL
     JOIN tb1
     ON land_area.total_area_sq_mi = tb1.deforest),
tb3 AS
    (SELECT *,
     CASE
     WHEN deforest IS NULL THEN
     1324449
     ELSE NULL
     END AS new_deforest
     From tb2)
```

```sql

SELECT  country_name,
        total_area_sq_km
FROM tb3
WHERE total_area_sq_km < new_deforest and year = 2016
ORDER BY total_area_sq_km DESC
LIMIT 1;
```

## REGIONAL OUTLOOK:

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

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

SELECT region,
 Round(((Sum(forest_area_sqkm) /
Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS
percent_forest
FROM Forestation
WHERE YEAR = 2016
GROUP BY region
ORDER BY percent_forest DESC
```

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?

```
81   SELECT  region,
82           Round(((Sum(forest_area_sqkm) /
             Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS
83           percent_forest
84   FROM Forestation
85   WHERE YEAR = 2016
86   GROUP BY region
87   ORDER BY percent_forest 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?

```
81   SELECT  region,
82           Round(((Sum(forest_area_sqkm) /
             Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS
83           percent_forest
84   FROM Forestation
85   WHERE YEAR = 1990
86   GROUP BY region
87   ORDER BY percent_forest DESC;
```

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

```
98   WITH t1 AS
99       (SELECT region,
100             SUM(forest_area_sqkm) as forest_sum_1990
101      FROM forestation
102      WHERE year = 1990
103       AND region NOT LIKE 'World'
104       GROUP BY 1),
```

```
105     t2 AS
106        (SELECT region, SUM(forest_area_sqkm) as
       forest_sum_2016
107        FROM forestation
108        WHERE year = 2016
109         AND region NOT LIKE 'World'
110        GROUP BY 1)
111
112   Select t1.region, t1.forest_sum_1990, t2.forest_sum_2016
113   FROM t1
114   JOIN t2
115    ON t1.region = t2.region
116   WHERE t2.forest_sum_2016 < t1.forest_sum_1990;
```

## 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?

```
138   WITH T1 AS
139    (SELECT country_name,
140    SUM(forest_area_sqkm) forest_area_1
141    FROM forestation
142    WHERE YEAR = 1990
143    GROUP BY country_name,
144    forest_area_sqkm),
145    T2 AS
146    (SELECT country_name,
147    SUM(forest_area_sqkm) forest_area_2
148    FROM forestation
149    WHERE YEAR = 2016
150    GROUP BY country_name,
151    forest_area_sqkm)
152   SELECT f.country_name,
153    (f.forest_area_1 - t.forest_area_2) forest_change
```

```
154    FROM T1 f
155    JOIN T2 t ON f.country_name = t.country_name
156    WHERE f.forest_area_1 IS NOT NULL
157     AND t.forest_area_2 IS NOT NULL
158     AND f.country_name != 'World'
159    ORDER BY forest_change DESC
160    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?

```
162   WITH T1 AS
163    (SELECT country_name,
164    (SUM(forest_area_sqkm) /
      SUM(total_area_sq_mi*2.59))*100 percent_forestation_1
165    FROM forestation
166    WHERE YEAR = 1990
167    GROUP BY country_name,
168    forest_area_sqkm),

169     T2 AS
170     (SELECT country_name,
171     (SUM(forest_area_sqkm) /
       SUM(total_area_sq_mi*2.59))*100 percent_forestation_2
172     FROM forestation
173     WHERE YEAR = 2016
174     GROUP BY country_name,
175     forest_area_sqkm)
176    SELECT f.country_name,
177     Round((((f.percent_forestation_1 -
178    t.percent_forestation_2)/(f.percent_forestation_1))*1
       00)::Numeric, 2) percent_change
179    FROM T1 f
180    JOIN T2 t ON f.country_name = t.country_name
181    WHERE f.percent_forestation_1 IS NOT NULL
182     AND t.percent_forestation_2 IS NOT NULL
183     AND f.country_name != 'World'
184    ORDER BY percent_change DESC
185    LIMIT 5;
```

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

```
187   WITH T1 AS
188    (SELECT country_name,
189    YEAR,
190    (SUM(forest_area_sqkm) /
      SUM(total_area_sq_mi*2.59))*100 percent_forestation
191    FROM forestation
192    WHERE YEAR = 2016
193    GROUP BY country_name,
194    YEAR,
195    forest_area_sqkm)
196  SELECT Distinct(quartiles),
197   count(country_name)Over(PARTITION BY quartiles)
198  FROM
199   (SELECT country_name,
200   CASE
201   WHEN percent_forestation<25 THEN '0-25'
202   WHEN percent_forestation>=25
203   AND percent_forestation<50 THEN '25-50'
204   WHEN percent_forestation>=50
205   AND percent_forestation<75 THEN '50-75'
206   ELSE '75-100'
207   END AS quartiles
208   FROM T1
209   WHERE percent_forestation IS NOT NULL
210   AND YEAR = 2016) sub
```

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

```
212     WITH T2 AS
213    (WITH T1 AS
214    (SELECT country_name,
215    YEAR,
216    (SUM(forest_area_sqkm) /
      SUM(total_area_sq_mi*2.59))*100 percent_forestation
217    FROM forestation
218    WHERE YEAR = 2016
219    GROUP BY country_name,
220    YEAR,
```

```
221     forest_area_sqkm) SELECT Distinct(quartiles),
222     count(country_name)Over(PARTITION BY quartiles),
223     country_name,
224     percent_forestation
225     FROM
226     (SELECT country_name,
227     percent_forestation,
228     CASE
229     WHEN percent_forestation<=25 THEN '0-25'
230     WHEN percent_forestation>25
231     AND percent_forestation<=50 THEN '25-50'
232     WHEN percent_forestation>50
233     AND percent_forestation<=75 THEN '50-75'
234     ELSE '75-100'
235     END AS quartiles
236     FROM T1
237     WHERE percent_forestation IS NOT NULL
238     AND YEAR = 2016) sub)
239   SELECT country_name,
240     quartiles,
241     Round(percent_forestation::Numeric, 2)
      percent_forestation
242   FROM T2
243   WHERE quartiles = '75-100'
244   ORDER BY percent_forestation DESC;
```

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

```
267   SELECT COUNT(country_name)
268     FROM forestation
269     WHERE year = 2016
270       AND percent_forestation >
271     (SELECT percent_forestation
272      FROM forestation
273      WHERE country_name = 'United States'
274       AND year = 2016)
```