Report for ForestQuery into Global Deforestation, 1990 to 2016

BY TOLUWALASE OKUWOGA

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*** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to ***39958245.9***, a loss of ***1324449***, or ***3.208%.***

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 ***1279999.99***).

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 & Carribean**, with

119.56%, and the region with the lowest relative forestation was **Middle East & North Africa**, with ***5.36 %*** 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 ***132.17%,*** and the region with the lowest relative forestation was ***Middle East & North Africa***, with ***4.60%*** forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	132.17	119.56
Europe & Central Asia	96.57	98.53
North America	92.34	93.34
Sub-Saharan Africa	79.45	74.56
East Asia & Pacific	66.76	68.27
South Asia	42.76	45.34
Middle East & North Africa	4.60	5.36

The only regions of the world that decreased in percent forest area from 1990 to 2016 were ***Latin America & Caribbean*** (dropped from ***132.17***% to ***119.56***%) and ***Sub-Saharan***

***Africa* (79.45%** to **74.56%**). 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 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 Amount Decrease in Forest Area by Country, 1990 & 2016:

Country	Region	Absolute Forest Area Change
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 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 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
75%-100%	9
50%-75%	38
25%-50%	73
0-25%	85

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
Suriname	Latin America & Caribbean	98.2576939676578
Micronesia, Fed. Sts.	East Asia & Pacific	91.8572390715248
Gabon	Sub-Saharan Africa	90.0376418700565
Seychelles	Sub-Saharan Africa	88.4111367385789
Palau	East Asia & Pacific	87.6068085491203
American Samoa	East Asia & Pacific	87.5000875000875
Guyana	Latin America & Caribbean	83.9014489110682
Lao PDR	East Asia & Pacific	82.1082317640861
Solomon Islands	East Asia & Pacific	77.8635177945066

94 countries had a percent forestation higher than the United States in 2016.

4. RECOMMENDATIONS

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

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

  Deforestation is happening rather quickly . *Analysis of the data has shown vast reduction of the global forest between 1990 and 2016. The most impacted region is Sub-Saharan Africa.*

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

  We need to focus on countries in Sub-Saharan Africa: Togo, Nigeria, Uganda, Mauritania

5. APPENDIX

Global Situation

```
CREATE VIEW forestation
AS
SELECT f.country_code code
  ,f.country_name country
  ,f.year "year"
  ,f.forest_area_sqkm forest_area_sqkm
  ,l.total_area_sq_mi total_area_sq_mi
  ,r.region region
  ,r.income_group income_group
  ,100.0 * (f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) AS percentage
FROM forest_area f
  ,land_area l
  ,regions r
WHERE (
    f.country_code = l.country_code
    AND f.year = l.year
    AND r.country_code = l.country_code
    );
```

a. **What was the total forest area (in sq km) of the world in 1990?**

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

b. **What was the total forest area (in sq km) of the world in 2016?**

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

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

```sql
SELECT (f1.forest_area_sqkm - f2.forest_area_sqkm) AS forest_area_diff
FROM forestation f1
  ,forestation f2
WHERE f1.year = 1990
  AND f1.region = 'World'
  AND f2.year = 2016
  AND f2.region = 'World';
```

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

```sql
SELECT (f1.forest_area_sqkm - f2.forest_area_sqkm) * 100 / f1.forest_area_sqkm AS pct_change
FROM forestation f1
  ,forestation f2
WHERE f1.year = 1990
  AND f1.region = 'World'
  AND f2.year = 2016
  AND f2.region = 'World';
```

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 t1
AS (
  SELECT MAX(forest_area_sqkm) - MIN(forest_area_sqkm) AS deforestation_1
  FROM forestation
  )
  ,t2
AS (
  SELECT *
    ,total_area_sq_mi * 2.59 AS total_area_sq_km
  FROM land_area l
  FULL JOIN t1 ON l.total_area_sq_mi = t1.deforestation_1
  )
  ,t3
AS (
  SELECT *
    ,CASE
      WHEN deforestation_1 IS NULL
        THEN 1324449
      ELSE NULL
      END AS deforestation_2
  FROM t2
  )
SELECT country_name
  ,total_area_sq_km
FROM t3
WHERE total_area_sq_km < deforestation_2
  AND YEAR = 2016
ORDER BY total_area_sq_km DESC;
```

Regional Outlook

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?

-- Percentage of forest of the entire world in 2016

```sql
SELECT percentage
FROM forestation
WHERE year = 2016
  AND country = 'World';
```

-- Region with the HIGHEST percent of forest in 2016 (rounded to 2 decimal place)

```sql
SELECT region
  ,ROUND(CAST(percent_forest AS NUMERIC), 2)
FROM (
  SELECT region
    ,SUM(forest_area_sqkm) * 100 / SUM(total_area_sq_mi) AS percent_forest
  FROM forestation
  WHERE year = 2016
  GROUP BY 1
  ) sub
ORDER BY 2 DESC LIMIT 1;
```

-- Region with the LOWEST percent of forest in 2016 (rounded to 2 decimal place)

```sql
SELECT region
  ,ROUND(CAST(percent_forest AS NUMERIC), 2)
FROM (
  SELECT region
    ,SUM(forest_area_sqkm) * 100 / SUM(total_area_sq_mi) AS percent_forest
  FROM forestation
  WHERE year = 2016
  GROUP BY 1
  ) sub
ORDER BY 2 LIMIT 1;
```

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?

```sql
SELECT region
  ,ROUND(CAST((region_forest_1990 / region_area_1990) * 100 AS NUMERIC), 2) AS forest_percent_1990
  ,ROUND(CAST((region_forest_2016 / region_area_2016) * 100 AS NUMERIC), 2) AS forest_percent_2016
FROM (
  SELECT SUM(f1.forest_area_sqkm) region_forest_1990
    ,SUM(f1.total_area_sq_mi) region_area_1990
    ,f1.region
    ,SUM(f2.forest_area_sqkm) region_forest_2016
    ,SUM(f2.total_area_sq_mi) region_area_2016
  FROM forestation f1
    ,forestation f2
  WHERE f1.year = '1990'
    AND f1.country != 'World'
    AND f2.year = '2016'
    AND f2.country != 'World'
    AND f1.region = f2.region
  GROUP BY f1.region
  ) region_percent
ORDER BY forest_percent_1990 DESC;
```

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

```sql
WITH t1
AS (
  SELECT region
    ,SUM(forest_area_sqkm) AS forest_sum_1990
  FROM forestation
  WHERE year = 1990
    AND region NOT LIKE 'World'
  GROUP BY 1
  )
  ,t2
AS (
  SELECT region
    ,SUM(forest_area_sqkm) AS forest_sum_2016
  FROM forestation
  WHERE year = 2016
    AND region NOT LIKE 'World'
  GROUP BY 1
  )
SELECT t1.region
  ,t1.forest_sum_1990
  ,t2.forest_sum_2016
FROM t1
JOIN t2 ON t1.region = t2.region
WHERE t2.forest_sum_2016 < t1.forest_sum_1990;
```

Country-Level Data

```
SELECT f1.country_name
  ,f1.forest_area_sqkm - f2.forest_area_sqkm AS difference
FROM forest_area AS f1
JOIN forest_area AS f2 ON (
    f1.year = '2016'
    AND f2.year = '1990'
    )
  AND f1.country_name = f2.country_name
ORDER BY difference DESC;
```

```
SELECT f1.country_name
  ,100.0 * (f1.forest_area_sqkm - f2.forest_area_sqkm) / f2.forest_area_sqkm AS percentage
FROM forest_area AS f1
JOIN forest_area AS f2 ON (
    f1.year = '2016'
    AND f2.year = '1990'
    )
  AND f1.country_name = f2.country_name
ORDER BY percentage DESC;
```

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 f1.country_name
  ,f1.forest_area_sqkm - f2.forest_area_sqkm AS difference
FROM forest_area AS f1
JOIN forest_area AS f2 ON (
    f1.year = '2016'
    AND f2.year = '1990'
    )
  AND f1.country_name = f2.country_name
ORDER BY difference;
```

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?**

```sql
SELECT f1.country_name
  ,100.0 * (f1.forest_area_sqkm - f2.forest_area_sqkm) / f2.forest_area_sqkm AS percentage
FROM forest_area AS f1
JOIN forest_area AS f2 ON (
    f1.year = '2016'
    AND f2.year = '1990'
    )
  AND f1.country_name = f2.country_name
ORDER BY percentage;
```

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

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

d. List ALL of the countries that were IN the 4th quartile (percent forest > 75%) IN 2016.

```sql
SELECT country
  ,percentage
FROM forestation
WHERE percentage > 75
  AND year = 2016
ORDER BY percentage DESC;
```

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

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