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 **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 **3.21**%.

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 **1279999.99km2**).

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 **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 **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*	*282193.98*
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
0-25%	85
25-50%	73
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
American Samoa	Sub-Saharan Africa	87.50
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Palau	East Asia & Pacific	87.61

4. RECOMMENDATIONS

Our main focus should be on the countries of the Sub-Saharan Africa region, which are shown to be the countries with the highest deforestation rates.

5. SQL Queries used

```sql
-- Create View
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)
```

```sql
SELECT *
FROM forest_area
WHERE country_name = 'World';


SELECT *
FROM forest_area
WHERE country_name = 'World'
AND (year = 2016 OR year = 1990);
-- country_code  country_name year forest_area_sqkm
-- WLD           World             2016 39958245.9
-- WLD           World             1990 41282694.9


SELECT
 curr.forest_area_sqkm - prev.forest_area_sqkm
 AS difference
FROM forest_area AS curr
JOIN forest_area AS prev
 ON   (curr.year = '2016' AND prev.year = '1990'
 AND curr.country_name = 'World' AND prev.country_name = 'World');
-- difference
-- -1324449


SELECT
 100.0*(curr.forest_area_sqkm - prev.forest_area_sqkm) /
 prev.forest_area_sqkm AS percentage
FROM forest_area AS curr
JOIN forest_area AS prev
 ON   (curr.year = '2016' AND prev.year = '1990'
 AND curr.country_name = 'World' AND prev.country_name = 'World');
-- percentage
-- -3.20824258980244


SELECT country, (total_area_sq_mi * 2.59) AS total_area_sqkm
FROM forestation
WHERE year = 2016
ORDER BY total_area_sqkm;
-- Peru   1279999.9891
```

```sql
SELECT percentage
FROM forestation
WHERE year = 2016
AND country = 'World';
-- 31.3755709643095

SELECT *
FROM forestation
WHERE year = 1990
AND country = 'World';
-- 32.4222035575689


SELECT 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,
 region
FROM (SELECT SUM(a.forest_area_sqkm) region_forest_1990,
 SUM(a.total_area_sqkm) region_area_1990, a.region,
 SUM(b.forest_area_sqkm) region_forest_2016,
 SUM(b.total_area_sqkm)  region_area_2016
FROM  forestation a, forestation b
WHERE  a.year = '1990'
AND a.country != 'World'
AND b.year = '2016'
AND b.country != 'World'
AND a.region = b.region
GROUP  BY a.region) region_percent
ORDER  BY forest_percent_1990 DESC;
-- forest_percent_1990 forest_percent_2016 region
-- 51.03               46.16               Latin America & Caribbean
-- 37.28               38.04               Europe & Central Asia
-- 35.65               36.04               North America
-- 30.67               28.79               Sub-Saharan Africa
-- 25.78               26.36               East Asia & Pacific
-- 16.51               17.51               South Asia
-- 1.78                2.07                Middle East & North Africa
```

```sql
SELECT curr.country_name,
 curr.forest_area_sqkm - prev.forest_area_sqkm AS difference
FROM forest_area AS curr
JOIN forest_area AS prev
 ON  (curr.year = '2016' AND prev.year = '1990')
 AND curr.country_name = prev.country_name
ORDER BY difference DESC;
-- China          527229.062
-- United States 79200
```

```sql
SELECT curr.country_name,
 100.0*(curr.forest_area_sqkm - prev.forest_area_sqkm) /
 prev.forest_area_sqkm AS percentage
FROM forest_area AS curr
JOIN forest_area AS prev
 ON  (curr.year = '2016' AND prev.year = '1990')
 AND curr.country_name = prev.country_name
ORDER BY percentage DESC;
-- Iceland          213.664588870028
-- French Polynesia  181.818181818182
```

```sql
SELECT curr.country_name,
 curr.forest_area_sqkm - prev.forest_area_sqkm AS difference
FROM forest_area AS curr
JOIN forest_area AS prev
 ON  (curr.year = '2016' AND prev.year = '1990')
 AND curr.country_name = prev.country_name
ORDER BY difference;
-- Brazil     -541510
-- Indonesia -282193.9844
-- Myanmar    -107234.0039
-- Nigeria    -106506.00098
-- Tanzania   -102320
```

```sql
SELECT curr.country_name,
 100.0*(curr.forest_area_sqkm - prev.forest_area_sqkm) /
 prev.forest_area_sqkm AS percentage
FROM forest_area AS curr
JOIN forest_area AS prev
 ON  (curr.year = '2016' AND prev.year = '1990')
 AND curr.country_name = prev.country_name
ORDER BY percentage;
-- Togo         -75.4452559270073
-- Nigeria      -61.7999309388418
-- Uganda       -59.1286034729531
-- Mauritania   -46.7469879518072
-- Honduras     -45.0344149459194


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;
-- quartiles count
-- 0-25%      85
-- 25-50%     73
-- 50-75%     38
-- 75-100%    9
```

```sql
SELECT country, percentage
FROM forestation
WHERE percentage > 75 AND year = 2016;
-- country                  percentage
-- American Samoa           87.5000875000875
-- Micronesia, Fed. Sts.    91.8572390715248
-- Gabon                    90.0376418700565
-- Guyana                   83.9014489110682
-- Lao PDR                  82.1082317640861
-- Palau                    87.6068085491204
-- Solomon Islands          77.8635177945066
-- Suriname                 98.2576939676578
-- Seychelles               88.4111367385789


-- SELECT quartile.ntile, COUNT(ntile)
-- FROM (SELECT country, NTILE(4) OVER
--     (ORDER BY percentage)
--     FROM forestation
--     WHERE year = 2016)
--     AS quartile;
-- ntile count
-- 4       54
-- 1       55
-- 3       54
-- 2       55
```