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** [1] in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9** [2], a loss of **1324449 sq. km** [3], or **-3.21%** [4].

The forest area lost over this time period is slightly more than the entire land area of **1279999.99 sq. km** [5] listed for the year 2016 (which is **Peru** [5]).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was **31.38%** [6]. The region with the highest relative forestation was **Latin America & Caribbean** [7], with **46.16%** [7], and the region with the lowest relative forestation was **Middle East & North Africa** [8], with **2.07%** [8] forestation.

In 1990, the percent of the total land area of the world designated as forest was **32.42%** [9]. The region with the highest relative forestation was **Latin America & Caribbean** [10], with **51.03%** [10], and the region with the lowest relative forestation was **Middle East & North Africa** [11], with **1.78%** [11] forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016 [12]:

Region	1990 Forest Percentage	2016 Forest Percentage
Middle East & North Africa	1.78	2.07
South Asia	16.51	17.51
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
North America	35.65	36.04
World	32.42	31.38
Sub-Saharan Africa	30.67	28.79
Latin America & Caribbean	51.03	46.16

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America & Caribbean** [12] (dropped from **51.03%** [12] to **46.16%** [12]) and **Sub-Saharan Africa** [12] (**30.67%** [12] to **28.79%** [12]). 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%** [12] to **31.38%** [12].

3. **COUNTRY-LEVEL DETAIL**

A. SUCCESS STORIES

There is one particularly bright spot in the data at the country level, **French Polynesia** [13]. This country actually increased in forest area from 1990 to 2016 by **27.32%** [13]. 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 **Puerto Rico** [13], but it only saw an increase of **23.93%** [13], much lower than the figure for **French Polynesia** [13].

Russian Federation [14] and **China** [14] 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. **French Polynesia** [13] increased in forest area by **27.32%** [13] 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 [15]:

Country	Region	Absolute Forest Area Change
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234
Nigeria	Sub-Saharan Africa	106506
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 [16]:

Country	Region	Pct Forest Area Change
Togo	Sub-Saharan Africa	-75.46
Nigeria	Sub-Saharan Africa	-61.79
Uganda	Sub-Saharan Africa	-59.29
Mauritania	Sub-Saharan Africa	-47.5
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 [16]. The countries are **Togo** [16], **Nigeria** [16], **Uganda** [16], and **Mauritania** [16]. The 5th country on the list is **Honduras** [16], which is in the **Latin America & Caribbean** [16] region.

From the above analysis, we see that **Nigeria** [16] 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 [17]:

Quartile	Number of Countries
First Quartile (0-25%)	85
Second Quartile (25-50%)	73
Third Quartile (50-75%)	38
Fourth Quartile (75-100%)	9

The largest number of countries in 2016 were found in the **first quartile (0-25%)** [17].

There were **9** [17] 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 [18]:

Country	Region	Pct Designated as Forest
American Samoa	East Asia & Pacific	87.5
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Palau	East Asia & Pacific	87.61
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26
Seychelles	Sub-Saharan Africa	88.41

4. RECOMMENDATIONS

A. HIGHEST PRIORITY

Based on understanding of forestation trends in the level of regions and countries, we can consider our highest priority is **the first quartile countries** [18], then analyzing their population relative to the forest areas and how the green areas are distributed relative to the entire country area; in order give detailed suggestions and help their governments to make better decisions.

B. WORLD BANK DATA

It doesn't matter whether the forest areas are productive or not unless they are natural. Although, Trends of forest areas (% of land area) is a good metric for monitoring each country. We can set a warning percentage threshold for each country, so they can be notified along with the suggestions provided.

5. APPENDIX: SQL QUERIES USED

View

```
CREATE OR REPLACE VIEW forestation AS
SELECT r.country_code,
       r.country_name,
       r.region,
       r.income_group,
       fa.year,
       fa.forest_area_sqkm,
       la.total_area_sq_mi * 2.59 AS total_area_sqkm,
       ROUND(fa.forest_area_sqkm / (la.total_area_sq_mi * 2.59) * 100, 2) AS
forest_percentage
FROM regions r
JOIN forest_area fa ON r.country_code = fa.country_code
JOIN land_area la ON fa.country_code = la.country_code AND
                     fa.year = la.year;
```

Global Situation

1. World Total Forest Area (sq. km) in 1990

```
SELECT forest_area_sqkm
FROM forestation
WHERE country_code = 'WLD' AND year = 1990;
```

2. World Total Forest Area (sq. km) in 2016

```
SELECT forest_area_sqkm
FROM forestation
WHERE country_code = 'WLD' AND year = 2016;
```

3. World Forest Area Change [1990-2016] (sq. km)

```
SELECT ROUND(SUM(forest_area_sqkm) FILTER ( WHERE year = 2016 )
           - SUM(forest_area_sqkm) FILTER ( WHERE year = 1990 ), 2) forest_area_change
FROM forestation
WHERE country_code = 'WLD';
```

4. World Forest Percentage Change [1990-2016]

```
SELECT ROUND(100 * (SUM(forest_percentage) FILTER ( WHERE year = 2016 )
            - SUM(forest_percentage) FILTER ( WHERE year = 1990 ))
            / SUM(forest_percentage) FILTER ( WHERE year = 1990 )
            , 2) AS forest_percentage_change
FROM forestation
WHERE country_code = 'WLD';
```

5. Most Forest Area Lost Comparing to the Entire World (sq. km)

```
WITH forest_area_delta AS (
  SELECT SUM(forest_area_sqkm) FILTER ( WHERE year = 2016 )
            - SUM(forest_area_sqkm) FILTER ( WHERE year = 1990 ) AS value
  FROM forestation
  WHERE country_code = 'WLD'
)

SELECT country_code,
       country_name,
       total_area_sqkm
FROM forestation
WHERE year = 2016 AND
      ABS(total_area_sqkm - (SELECT ABS(value) FROM forest_area_delta))
          = (SELECT MIN(ABS(total_area_sqkm - (SELECT ABS(value)
                                               FROM forest_area_delta)))
             FROM forestation);
```

Regional Outlook

6. Forest Percentage of Entire World in 2016

```
SELECT country_name region,
  forest_percentage
FROM forestation
WHERE year = 2016 AND
      country_code = 'WLD';
```

7. Region with Highest Relative Forestation in 2016

```
SELECT region,
       ROUND(SUM(forest_area_sqkm)
             / SUM(total_area_sqkm) * 100, 2) AS forest_percentage
FROM forestation
WHERE year = 2016
GROUP BY region
HAVING SUM(forest_area_sqkm) / SUM(total_area_sqkm)
    = (SELECT MAX(forest_ratio)
       FROM (SELECT SUM(forest_area_sqkm) / SUM(total_area_sqkm) AS forest_ratio
             FROM forestation
             WHERE year = 2016
             GROUP BY region) t);
```

8. Region with Lowest Relative Forestation in 2016

```
SELECT region,
       ROUND(SUM(forest_area_sqkm)
             / SUM(total_area_sqkm) * 100, 2) AS forest_percentage
FROM forestation
WHERE year = 2016
GROUP BY region
HAVING SUM(forest_area_sqkm) / SUM(total_area_sqkm)
    = (SELECT MIN(forest_ratio)
       FROM (SELECT SUM(forest_area_sqkm) / SUM(total_area_sqkm) AS forest_ratio
             FROM forestation
             WHERE year = 2016
             GROUP BY region) t);
```

9. Forest Percentage of Entire World in 1990

```
SELECT country_name region,
  forest_percentage
FROM forestation
WHERE year = 1990 AND
      country_code = 'WLD';
```

10. Region with Highest Relative Forestation in 1990

```
SELECT region,
       ROUND(SUM(forest_area_sqkm)
             / SUM(total_area_sqkm) * 100, 2) AS forest_percentage
FROM forestation
WHERE year = 1990
GROUP BY region
HAVING SUM(forest_area_sqkm) / SUM(total_area_sqkm)
    = (SELECT MAX(forest_ratio)
       FROM (SELECT SUM(forest_area_sqkm) / SUM(total_area_sqkm) AS forest_ratio
             FROM forestation
             WHERE year = 1990
             GROUP BY region) t);
```

11. Region with Lowest Relative Forestation in 1990

```
SELECT region,
       ROUND(SUM(forest_area_sqkm)
             / SUM(total_area_sqkm) * 100, 2) AS forest_percentage
FROM forestation
WHERE year = 1990
GROUP BY region
HAVING SUM(forest_area_sqkm) / SUM(total_area_sqkm)
    = (SELECT MIN(forest_ratio)
       FROM (SELECT SUM(forest_area_sqkm) / SUM(total_area_sqkm) AS forest_ratio
             FROM forestation
             WHERE year = 1990
             GROUP BY region) t);
```

12. Percent Forest Area by Region, 1990 & 2016

```
SELECT region, forest_percentage_1990, forest_percentage_2016
FROM (SELECT region,
             ROUND(100 * SUM(forest_area_sqkm) FILTER ( WHERE year = 1990 )
                       / SUM(total_area_sqkm) FILTER ( WHERE year = 1990 )
                       , 2) AS forest_percentage_1990,
             ROUND(100 * SUM(forest_area_sqkm) FILTER ( WHERE year = 2016 )
                       / SUM(total_area_sqkm) FILTER ( WHERE year = 2016 )
                       , 2) AS forest_percentage_2016
      FROM forestation
      GROUP BY region) t
ORDER BY (forest_percentage_2016 - forest_percentage_1990) / forest_percentage_1990
DESC;
```

Country-Level Detail

13. Countries with Largest Increase in Forest Area [1990-2016]

```
SELECT f_1990.country_name,
       f_1990.region,
       ROUND(f_2016.forest_percentage - f_1990.forest_percentage
           , 2) AS forest_pct_increase
FROM (SELECT country_code, country_name, region, forest_percentage
      FROM forestation
      WHERE year = 1990 AND
            country_code <> 'WLD' AND
            COALESCE(forest_percentage, 0) <> 0) f_1990
JOIN (SELECT country_code, country_name, region, forest_percentage
      FROM forestation
      WHERE year = 2016 AND
            country_code <> 'WLD' AND
            COALESCE(forest_percentage, 0) <> 0) f_2016
ON f_1990.country_code = f_2016.country_code
ORDER BY forest_pct_increase DESC
LIMIT 2;
```

14. Forest Area Change in Countries with Largest Land Area [1990-2016]

```
SELECT f_1990.country_name,
       f_1990.region,
       ROUND(f_2016.forest_percentage - f_1990.forest_percentage
            , 2) AS forest_pct_increase
FROM (SELECT country_code, country_name, region, total_area_sqkm, forest_percentage
      FROM forestation
      WHERE year = 1990 AND
            country_code <> 'WLD' AND
            COALESCE(forest_percentage, 0) <> 0) f_1990
JOIN (SELECT country_code, country_name, region, total_area_sqkm, forest_percentage
      FROM forestation
      WHERE year = 2016 AND
            country_code <> 'WLD' AND
            COALESCE(forest_percentage, 0) <> 0) f_2016
ON f_1990.country_code = f_2016.country_code
ORDER BY f_1990.total_area_sqkm DESC
LIMIT 2;
```

15. Countries with Largest Forest Area Decrease [1990-2016]

```
SELECT f_1990.country_name,
       f_1990.region,
       ROUND(ABS(f_2016.forest_area_sqkm - f_1990.forest_area_sqkm)
             , 2) forest_amount_delta
FROM (SELECT country_code, country_name, region, forest_area_sqkm
      FROM forestation
      WHERE year = 1990 AND
            country_code <> 'WLD' AND
            COALESCE(forest_area_sqkm, 0) <> 0) f_1990
JOIN (SELECT country_code, country_name, region, forest_area_sqkm
      FROM forestation
      WHERE year = 2016 AND
            country_code <> 'WLD' AND
            COALESCE(forest_area_sqkm, 0) <> 0) f_2016
ON f_1990.country_code = f_2016.country_code
ORDER BY f_2016.forest_area_sqkm - f_1990.forest_area_sqkm
LIMIT 5;
```

16. Countries with Largest Forest Percentage Decrease [1990-2016]

```
SELECT f_1990.country_name,
       f_1990.region,
       ROUND(100 * (f_2016.forest_percentage - f_1990.forest_percentage)
             / f_1990.forest_percentage, 2) forest_area_change_pct
FROM (SELECT country_code, country_name, region, forest_percentage
      FROM forestation
      WHERE year = 1990 AND
            country_code <> 'WLD' AND
            COALESCE(forest_percentage, 0) <> 0) f_1990
JOIN (SELECT *
      FROM forestation
      WHERE year = 2016 AND
            country_code <> 'WLD' AND
            COALESCE(forest_percentage, 0) <> 0) f_2016
ON f_1990.country_code = f_2016.country_code
ORDER BY forest_area_change_pct
LIMIT 5;
```

17. Count of Countries Grouped by Forestation Percent Quartiles, 2016

```
SELECT CASE WHEN forest_percentage BETWEEN 0 AND 25 THEN 'First Quartile (0-25%)'
            WHEN forest_percentage BETWEEN 25 AND 50 THEN 'Second Quartile (25-50%)'
            WHEN forest_percentage BETWEEN 50 AND 75 THEN 'Third Quartile (50-75%)'
            WHEN forest_percentage BETWEEN 75 AND 100 THEN 'Fourth Quartile (75-100%)'
        END quartile,
       COUNT(1) countries_count
FROM forestation
WHERE year = 2016 AND
      forest_percentage <= 100
GROUP BY 1
ORDER BY 2 DESC;
```

18. Top Quartile Countries, 2016

```
SELECT country_code, country_name, region, forest_percentage
FROM forestation
WHERE year = 2016 AND
      forest_percentage > 75
ORDER BY forest_percentage DESC;
```

19. Countries Count Had Higher Forest Percentage than US, 2016

```
SELECT COUNT(1)
FROM forestation
WHERE year = 2016 AND
      forest_percentage > (SELECT forest_percentage FROM forestation WHERE
country_code = 'USA' AND year = 2016);
```