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 square kilometers** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 square kilometers**, a loss of **1324449 square kilometers**, 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 **1279999.9891 square kilometer**).

2. REGIONAL OUTLOOK

In 2016, the percentage 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 **46.14%**, 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 **51.08%**, 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: **SELECTED TOP 3**

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51.08%	46.14%
Europe & Central Asia	37.20%	38.07%
North America	35.66%	36.02%

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America & Caribbean** (dropped from **51.08%** to **46.14%**) 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 **32.41%** 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 square kilometers**. 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 square kilometers**, much lower than the figure for **China**.

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's** forest area increased 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**
Myanmar	**East Asia & Pacific**	**-107234**

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%**

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 (<25%)	**85**

2 (25-50%	73
3 (50-75%)	37
4 (>75%)	9

The largest number of countries in 2016 were found in the **first (or lowest)** 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**	**98.26%**
Micronesia, Fed. Sts.	**East Asia & Pacific**	**91.86%**
Gabon	**Sub-Saharan Africa**	**90.04%**

5. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.
- *What have you learned from the World Bank data?*
- *Which countries should we focus on over others?*

That Sub Saharan Africa is losing forest at the highest rate. Considering climate change this may not entirely be by choice. China seems to be very invested in restoring their nature, which I did not expect. In order to choose which countries to focus on this dataset should be analyzed by anthropologists so that it can be determined which countries are causing the most environmental damage by choice. Since this is naturally reversible, this countries should be first priority.

5. APPENDIX (QUERIES)

Forestation VIEW

DROP VIEW IF EXISTS forestation;

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

Global situation

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

```
SELECT country_name, year, forest_area
FROM forestation
WHERE country_name = 'World' AND year = 1990
GROUP BY 1, 2, 3;
```

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

```
SELECT country_name, year, forest_area
FROM forestation
WHERE country_name = 'World' AND year = 2016
GROUP BY 1, 2, 3;
```

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

```
SELECT area_1990.forest_area-area_2016.forest_area AS world_sqkm_loss
FROM
(SELECT country_name, year, forest_area
        FROM forestation
WHERE year = 1990 AND region = 'World'
GROUP BY 1, 2, 3) AS area_1990
JOIN
        (SELECT country_name, year, forest_area
        FROM forestation
        WHERE year = 2016 AND region = 'World'
        GROUP BY 1, 2, 3) AS area_2016
ON
```

area_1990.country_name = area_2016.country_name;

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

SELECT ((area_1990.forest_area-area_2016.forest_area)/area_1990.forest_area)*100 AS world_percentage_loss
FROM
        (SELECT country_name, year, forest_area
        FROM forestation
        WHERE year = 1990 AND region = 'World'
        GROUP BY 1, 2, 3) AS area_1990
JOIN
        (SELECT country_name, year, forest_area
        FROM forestation
        WHERE year = 2016 AND region = 'World'
        GROUP BY 1, 2, 3) AS area_2016
ON
        area_1990.country_name = area_2016.country_name;

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 DISTINCT country_name, total_area
FROM forestation
WHERE total_area BETWEEN 1270000.00 AND 1380000.00
ORDER BY 2;

Regional_forestation VIEW

DROP VIEW IF EXISTS forestation;

CREATE VIEW regional_forestation AS(
        SELECT region, year, SUM(forest_area) AS sum_forest_area, SUM(total_area) AS sum_total_area, (SUM(forest_area)/SUM(total_area))*100 AS   percentage_forest
        FROM forestation
        GROUP BY 1,2);

Regional outlook

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 region, year, percentage_forest
FROM regional_forestation
WHERE year = 2016
GROUP BY 1, 2, 3
ORDER BY 3 DESC;
```

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 region, year, percentage_forest
FROM regional_forestation
WHERE year = 1990
GROUP BY 1, 2, 3
ORDER BY 3 DESC;
```

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

```
WITH
region_1990 AS(
        SELECT region, year, percentage_forest
        FROM regional_forestation
        WHERE year = 1990
        GROUP BY 1, 2, 3),
region_2016 AS (
        SELECT region, year, percentage_forest
        FROM regional_forestation
        WHERE year = 2016
        GROUP BY 1, 2, 3)
```

```
SELECT region_1990.region, region_1990.percentage_forest AS forest_area_1990,
region_2016.percentage_forest AS forest_area_2016
FROM region_1990
JOIN region_2016
ON region_1990.region = region_2016.region
WHERE region_1990.percentage_forest > region_2016.percentage_forest;
```

Country-level detail

Which 5 countries saw the largest amount decrease (add DESC for increase) in forest area from 1990 to 2016? What was the difference in forest area for each?

```
WITH
region_1990 AS (
        SELECT DISTINCT country_name, region, year, forest_area AS forest_area_1990
        FROM forestation
        WHERE country_name != 'World'  AND year = 1990 AND forest_area IS NOT NULL
GROUP BY 1, 2, 3, 4),
region_2016 AS (
        SELECT DISTINCT country_name, region, year, forest_area AS forest_area_2016
        FROM forestation
        WHERE country_name != 'World'  AND year = 2016 AND forest_area IS NOT NULL
GROUP BY 1, 2, 3, 4)

SELECT
region_1990.country_name,
region_1990.region,
region_1990.forest_area_1990,
region_2016.forest_area_2016,
region_2016.forest_area_2016-region_1990.forest_area_1990 AS forest_area_decrease
FROM region_1990
JOIN region_2016
ON region_1990.country_name = region_2016.country_name AND region_1990.region =
region_2016.region
ORDER BY 5
LIMIT 5;
```

Which 5 countries saw the largest percent decrease (add DESC for increase) in forest area from 1990 to 2016? What was the percent change to 2 decimal places for each?

```
WITH
region_1990 AS (
        SELECT DISTINCT country_name, region, year, forest_area AS forest_area_1990
        FROM forestation
        WHERE country_name != 'World'  AND year = 1990 AND forest_area IS NOT NULL
GROUP BY 1, 2, 3, 4),
region_2016 AS (
        SELECT DISTINCT country_name, region, year, forest_area AS forest_area_2016
        FROM forestation
        WHERE country_name != 'World'  AND year = 2016 AND forest_area IS NOT NULL
GROUP BY 1, 2, 3, 4)

SELECT
region_1990.country_name,
region_1990.region,
region_1990.forest_area_1990,
region_2016.forest_area_2016,
((region_2016.forest_area_2016-region_1990.forest_area_1990)/region_1990.forest_area_199
0)*100 AS forest_percent_decrease
FROM region_1990
JOIN region_2016
ON region_1990.country_name = region_2016.country_name AND region_1990.region =
region_2016.region
ORDER BY 5
LIMIT 5;
```

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

```
WITH
countries AS(
        SELECT country_name, year, AVG(percentage_forest)*100 AS avg_percentage_forest
        FROM forestation
        WHERE country_name != 'World' AND year=2016 AND forest_area IS NOT NULL AND
total_area IS NOT NULL
        GROUP BY 1, 2),
```

```
quartiles AS(
        SELECT countries.country_name, countries.year, countries.avg_percentage_forest,
        CASE
                WHEN countries.avg_percentage_forest >= 75 THEN 4
                WHEN countries.avg_percentage_forest < 75 AND
        countries.avg_percentage_forest >= 50 THEN 3
                WHEN countries.avg_percentage_forest < 50 AND
        countries.avg_percentage_forest >=25 THEN 2
                ELSE 1
        END AS percentile
        FROM countries)

SELECT quartiles.percentile, COUNT(quartiles.percentile)
FROM quartiles
GROUP BY 1
ORDER BY 2 DESC;
```

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

```
WITH
countries AS(
        SELECT country_name, region, year, AVG(percentage_forest)*100 AS
avg_percentage_forest
        FROM forestation
        WHERE country_name != 'World' AND year=2016 AND forest_area IS NOT NULL AND
total_area IS NOT NULL
        GROUP BY 1, 2, 3),
quartiles AS(
        SELECT countries.country_name, countries.region, countries.year,
countries.avg_percentage_forest,
        CASE
                WHEN countries.avg_percentage_forest >= 75 THEN 4
                WHEN countries.avg_percentage_forest < 75 AND
        countries.avg_percentage_forest >= 50 THEN 3
                WHEN countries.avg_percentage_forest < 50 AND
        countries.avg_percentage_forest >=25 THEN 2
                ELSE 1
        END AS percentile
        FROM countries)

SELECT country_name, region, avg_percentage_forest, percentile
```

```
FROM quartiles
WHERE quartiles.percentile = 4
ORDER BY 3 DESC;
```

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

```
WITH
countries AS(
        SELECT country_name, region, year, AVG(percentage_forest)*100 AS
avg_percentage_forest
        FROM forestation
        WHERE country_name != 'World' AND year=2016 AND forest_area IS NOT NULL AND
total_area IS NOT NULL
        GROUP BY 1, 2, 3),
quartiles AS(
        SELECT countries.country_name, countries.region, countries.year,
countries.avg_percentage_forest,
        CASE
                WHEN countries.avg_percentage_forest >= 75 THEN 4
                WHEN countries.avg_percentage_forest < 75 AND
        countries.avg_percentage_forest >= 50 THEN 3
                WHEN countries.avg_percentage_forest < 50 AND
        countries.avg_percentage_forest >=25 THEN 2
                ELSE 1
        END AS percentile
        FROM countries)

SELECT COUNT(*) AS "Countries with more forestation than the United States"
FROM countries
WHERE avg_percentage_forest > (
        SELECT countries.avg_percentage_forest
        FROM countries
        WHERE countries.country_name = 'United States')
```