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 **41,282,694.9** Km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9Km**, a loss of **1,324,449** KM, or **3.2%**.

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 **1,279,999.98 Km**).

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 %	2016 Forest %
Latin America & Caribbean	51.03	46.16
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
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 **527,229** Km. 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 **USA**, but it only saw an increase of 79,200, much lower than the figure for **China**.

China and **USA** 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	**541,510**
Indonesia	East Asia & Pacific	**282, 193.98**
Myanmar	East Asia & Pacific	**107234**
Nigeria	Sub-Saharan Africa	**106506**
Tanzania	Sub-Saharan Africa	**102,320**

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
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
Suriname	Latin America & Caribbean	98.26
Micronesia, Fed. Sts.	East Asia & Pacific	90.86
Gabon	Sub-Saharan Africa	90.04
Seychelles	Sub-Saharan Africa	88.41
Palau	East Asia & Pacific	87.61
American Samoa	East Asia & Pacific	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

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?*

The report has shown the following points:
- There is a significant decrease in world forestation area in the period 1990- 2016 (around 3.2% of the forestation areas have been lost during that 25 years) → a red alarm should be raised to combat for that devastating issue.
- A more detailed study might be needed to consider the following factors:
  - Climate change in relation to deforestation.
  - Economic activities and it's impact on the forestation.
  - Public policies regulating the fair usage of natural resources.
  - Adopting more eco-friendly activities to preserve natural resources.
- There should be more economic incentives packages to encourage countries preserve their forestation areas.
- Another dedicated study should be taken to analyze the factors that have resulted in deforestation for the top countries that lost significant forestation areas. The learned lessons from this study can serve as a guideline to protect other areas in the world.

6.0 Appendix – SQL queries used.

```
-- Initializing the workspace
DROP VIEW IF EXISTS forestation
-- Creating View
CREATE VIEW forestation AS
  SELECT f.country_code country_code, f.country_name country,
             f.year AS Year, f.forest_area_sqkm forest_area_sqkm,
              (l.total_area_sq_mi * 2.59) land_area_sqkm, r.region region,
      r.income_group income_group,
      ROUND(CAST(((f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) * 100)
      AS NUMERIC), 2) forest_percentage

  FROM forest_area f
  INNER JOIN  land_area l
  ON f.country_code = l.country_code
  AND f.year = l.year
  INNER JOIN regions r
  ON f.country_code = r.country_code
```

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

SELECT forest_area_sqkm World_forest_Arae_1990
FROM forestation
WHERE year = 1990 AND country = 'World';
-- 41,282,694.9
```

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

SELECT forest_area_sqkm World_forest_Arae_2016
FROM forestation
WHERE year = 2016 AND country = 'World';
-- 39,958,245.9
```

```
-- c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?
-- d. What was the percent change in forest area of the world between 1990 and 2016?
```

```sql
SELECT (_1990.forest_area_sqkm  - _2016.forest_area_sqkm) AS area_difference,
((_1990.forest_area_sqkm  - _2016.forest_area_sqkm) / _1990.forest_area_sqkm *100)
 AS area_diff_percentage
FROM forestation AS _1990
JOIN forestation AS _2016
ON _1990.year =1990 AND _2016.year =2016
AND _1990.country_name = 'World'
AND _2016.country_name = 'World'
-- 1,324,449 area difference
-- 3.2% percentage difference

--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?

SELECT country, land_area_sqkm
FROM forestation
WHERE ABS(land_area_sqkm - 1324449) < 100000 --Arbitrary vakue
ORDER BY 2 DESC
LIMIT 1
-- Peru      land_area_sqkm = 1279999.9891


/***************   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?

-- Percent forest entire world in 2016:
SELECT forest_percentage AS world_forest_2016
FROM forestation
WHERE year = 2016 AND country = 'World';
-- 31.38%

-- Getting the country with max forest_percentage in 2016
SELECT country, forest_percentage
FROM forestation
WHERE forest_percentage = (
        SELECT MAX(forest_percentage) AS max_forest_percentage
        FROM forestation
        WHERE year = 2016);
-- Country = Suriname, forest_percentage = 98.26

-- Getting the country with min forest_percentage in 2016
SELECT country, forest_percentage
```

```sql
FROM forestation
WHERE forest_percentage = (
        SELECT MIN(forest_percentage) AS min_forest_percentage
        FROM forestation
        WHERE year = 2016);
```

-- Country = Greenland, forest_percentage = 0%

-- 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 forest_percentage AS world_forest_1990
FROM forestation
WHERE year = 1990 AND country = 'World';
```
-- 32.42%

-- Getting the country with max forest_percentage in 1990
```sql
SELECT country, forest_percentage
FROM forestation
WHERE forest_percentage = (
        SELECT MAX(forest_percentage) AS max_forest_percentage
        FROM forestation
        WHERE year = 1990);
```

-- Country = Suriname, forest_percentage = 98.91%

-- Getting the country with min forest_percentage in 1990
```sql
SELECT country, forest_percentage
FROM forestation
WHERE forest_percentage = (
        SELECT MIN(forest_percentage) AS min_forest_percentage
        FROM forestation
        WHERE year = 1990);
```
-- Country = Greenland, forest_percentage = 0%

--Create a table that shows the Regions and their percent forest area
-- in 1990 and 2016.

```sql
WITH t1 AS(

    SELECT region,
    ROUND(CAST(SUM(forest_area_sqkm) AS NUMERIC), 2) AS forest_area
    FROM forestation
```

```
        WHERE year = 1990
        GROUP BY 1),
    t2 AS(
        SELECT region,
        ROUND(CAST(SUM(land_area_sqkm) AS NUMERIC), 2) AS land_area
        FROM forestation
        WHERE year = 1990
        GROUP BY 1),
    t3 AS(
        SELECT region,
        ROUND(CAST(SUM(forest_area_sqkm) AS NUMERIC), 2) AS forest_area
        FROM forestation
        WHERE year = 2016
        GROUP BY 1),
    t4 AS(
        SELECT region,
        ROUND(CAST(SUM(land_area_sqkm) AS NUMERIC), 2) AS land_area
        FROM forestation
        WHERE year = 2016
        GROUP BY 1)


SELECT t1.region,
    ROUND((t1.forest_area/t2.land_area*100), 2) _1990,
                    ROUND((t3.forest_area/t4.land_area*100), 2) _2016
FROM t1
JOIN t2 ON t1.region = t2.region
JOIN t3 ON t2.region = t3.region
JOIN t4 ON t3.region = t4.region
ORDER BY 2 DESC

--The Top 2 countries where forest_area has increased from 1990 and _2016
SELECT f1.country AS country_name,
    f1.forest_area_sqkm AS forest_area_1990,
    f2.forest_area_sqkm AS forest_area_2016
    f2.forest_area_sqkm - f1.forest_area_sqkm AS forest_area_gained
FROM forestation AS f1
JOIN forestation AS f2
ON f1.country = f2.country
AND f1.year = 1990 AND f2.year = 2016
ORDER BY 3 DESC;

-- China and USA
--The Top 1 country where forest_area_percenrage has increased from
```

--1990 and _2016

```sql
SELECT f1.country AS country_name,
     f1.forest_area_sqkm AS forest_area_1990,
     f2.forest_area_sqkm AS forest_area_2016,
     (100.0 *(f2.forest_area_sqkm - f1.forest_area_sqkm) / f1.forest_area_sqkm)
      AS forest_area_gained_percentage
FROM forestation AS f1
JOIN forestation AS f2
ON f1.country = f2.country
AND f1.year = 1990 AND f2.year = 2016
ORDER BY 4 DESC;
```

-- Iceland 213.66 %

-- 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?
```sql
SELECT f1.country,
              f1.region,
     f1.forest_area_sqkm - f2.forest_area_sqkm AS difference
FROM forestation AS f1
JOIN forestation AS f2
  ON  (f1.year = '2016' AND f2.year = '1990')
  AND f1.country = f2.country
ORDER BY 3;
```

--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,
              f1.region,
    (100.0 * (f1.forest_area_sqkm - f2.forest_area_sqkm) / f2.forest_area_sqkm)
      AS diff_percentage
FROM forestation AS f1
JOIN forestation AS f2
  ON  (f1.year = '2016' AND f2.year = '1990')
  AND f1.country = f2.country
ORDER BY 3;
```


-- 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)
```

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

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

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

```sql
SELECT country, region, forest_percentage
FROM forestation
WHERE forest_percentage > 75 AND year = 2016
ORDER BY 3 DESC;
```

```
-- country        region  forest_percentage
-- Suriname     Latin America & Caribbean    98.26
-- Micronesia, Fed. Sts.       East Asia & Pacific    91.86
-- Gabon         Sub-Saharan Africa    90.04
-- Seychelles   Sub-Saharan Africa    88.41
-- Palau        East Asia & Pacific    87.61
-- American Samoa   East Asia & Pacific    87.50
-- Guyana       Latin America & Caribbean    83.90
-- Lao PDR     East Asia & Pacific    82.11
-- Solomon Islands    East Asia & Pacific    77.86
```