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** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9**, a loss of **1,324,449**, 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 **1,280,000**).

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 the **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 the **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
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
South Asia	16.51	17.51
Sub-Saharan Africa	30.67	28.79

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**. 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 **79,200**, 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** increased in forest area by **212.50%** 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 (sqkm)
Brazil	Latin America & Caribbean	541,510
Indonesia	East Asia & Pacific	282,194
Myanmar	East Asia & Pacific	107,234
Nigeria	Sub-Saharan Africa	106,506
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	-75.46
Nigeria	Sub-Saharan Africa	-61.79
Uganda	Sub-Saharan Africa	-59.29
Mauritania	Sub-Saharan Africa	-47.50
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
1	85
2	73
3	38
4	9

The largest number of countries in 2016 were found in the **first** 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
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

4. RECOMMENDATIONS

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

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

Year	Area of annual forest loss in the world
1991	-72667
1992	-72668

1993	-72667
1994	-72667
1995	-72667
1996	-72668
1997	-72667
1998	-72667
1999	-72667
2000	-72668
2001	-45719
2002	-45719
2003	-45719
2004	-45719
2005	-45719
2006	-34139
2007	-34140
2008	-34139
2009	-34140
2010	-34139
2011	-33091
2012	-33079
2013	-33078
2014	-33079
2015	-33078
2016	-33079

The table above illustrates how much forest area was lost per year between 1990 and 2016. As can be observed, the trend is dropping, which is a good thing, but the situation is far from ideal.

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

There should be a global consensus on Latin America & Caribbean region and Sub-Saharan Africa region to stop further deforestation in these areas.

That seems there is a big concern about Brazil and Nigeria. Brazil has lost 541,510 square kilometers of its forest between 1990 and 2016, that is a huge number. Nigeria has lost 61% of its forest during the same period that is equivalent 106,506 square kilometers.

5. APPENDIX: SQL Queries Used

CREATE VIEW :

Creates a View called “forestation” by joining all three tables - forest_area, land_area, and regions.

```
CREATE VIEW forestation AS
SELECT r.region,
       r.income_group AS region_income_group,
       r.country_code,
       r.country_name,
       la.year,
       la.total_area_sq_mi * 2.59 AS total_area_sqkm,
       fa.forest_area_sqkm,
       round(((fa.forest_area_sqkm * 100) / (la.total_area_sq_mi *
2.59))::NUMERIC, 2) AS forest_percent
FROM  forest_area fa
JOIN land_area la ON fa.country_code=la.country_code AND fa.year=la.year
JOIN regions r ON fa.country_code = r.country_code
ORDER BY 1,3,5;
```

Queries of Part 1 :

```
-- Finds the total forest area of the world in 1990 1nd 2016, then finds how it
changed.
WITH
    world_1990 AS
    (SELECT f.country_name, f.forest_area_sqkm forest_area_1990
     FROM forestation f
     WHERE f.country_name='World' AND f.year=1990
    ),
    world_2016 AS
    (SELECT f.country_name, f.forest_area_sqkm forest_area_2016
     FROM forestation f
     WHERE f.country_name='World' AND f.year=2016
    )
SELECT
  y1990.forest_area_1990,
  y2016.forest_area_2016,
  ROUND((y1990.forest_area_1990 - y2016.forest_area_2016)::NUMERIC,2) diff_fa,
  ROUND(((y2016.forest_area_2016 - y1990.forest_area_1990) /
y1990.forest_area_1990 * 100)::NUMERIC,2) diff_percent
FROM world_1990 y1990
JOIN world_2016 y2016 ON y1990.country_name = y2016.country_name;
```

```sql
-- Finds the largest country whose total land area is less than the lost forest
area between 1990 and 2016.
SELECT f.country_name, ROUND(f.total_area_sqkm)
FROM forestation f
WHERE f.year=2016 AND f.total_area_sqkm <= 1324449
ORDER BY f.total_area_sqkm DESC
LIMIT 1;
```

Queries of Part 2 :

```sql
-- Finds the percent of the total forest area of the world in 1990, 2016.
SELECT f.year, f.forest_percent
FROM forestation f
WHERE f.country_name='World' AND f.year in (1990,2016);
```

```sql
-- Finds the percent of the total forest area of each region in 2016.
SELECT f.region,
ROUND(((SUM(f.forest_area_sqkm) * 100)/SUM(f.total_area_sqkm))::numeric,2)
forest_percent_2016
FROM forestation f
WHERE f.year=2016 AND f.region != 'World'
GROUP BY f.region
ORDER BY 1;
```

```sql
-- Finds the percent of the total forest area of each region in 1990.
SELECT f.region,
ROUND(((SUM(f.forest_area_sqkm) * 100)/SUM(f.total_area_sqkm))::numeric,2)
forest_percent_1990
FROM forestation f
WHERE f.year=1990 AND f.region != 'World'
GROUP BY f.region
ORDER BY 1;
```

Queries of Part 3 – Section A:

```sql
-- Finds top 2 countries with maximum amount increase in forest area between 1990
and 2016.
SELECT  y1990.country_name,
        ROUND((y2016.forest_area_sqkm -
y1990.forest_area_sqkm)::NUMERIC)  increased_amount
FROM forestation y1990
JOIN forestation y2016 ON y1990.country_code = y2016.country_code
WHERE y1990.year = 1990
      AND y2016.year = 2016
      AND y1990.forest_area_sqkm IS NOT NULL
      AND y2016.forest_area_sqkm IS NOT NULL
      AND y1990.country_name != 'World'
```

```
ORDER BY 2 DESC
LIMIT 2;
```

```
-- Finds top country with maximum percent increase in forest area between 1990
and 2016.
SELECT  y1990.country_name,
        ROUND((((y2016.forest_percent_2016 -
y1990.forest_percent_1990)/y1990.forest_percent_1990) * 100)::NUMERIC,2)
increased_percent
FROM
(SELECT f.country_code, f.country_name,
        f.forest_percent forest_percent_1990
 FROM forestation f
 WHERE f.year=1990 AND f.forest_percent IS NOT NULL) y1990
JOIN (SELECT f.country_code, f.country_name,
             f.forest_percent forest_percent_2016
      FROM forestation f
      WHERE f.year=2016 AND f.forest_percent IS NOT NULL) y2016
  ON y1990.country_code = y2016.country_code
WHERE y1990.country_name != 'World' AND y1990.forest_percent_1990 != 0
ORDER BY 2 DESC
LIMIT 1;
```

Queries of Part 3 – Section B:

```
-- Finds top 5 countries with maximum amount decrease in forest area between 1990
and 2016.
WITH
    forestation_1990 AS
    (SELECT f.country_code,
            f.country_name,
            f.region,
            f.forest_area_sqkm forest_area_1990
     FROM forestation f
     WHERE f.year=1990 AND f.forest_area_sqkm IS NOT NULL
    ),
    forestation_2016 AS
    (SELECT f.country_code,
            f.country_name,
            f.region,
            f.forest_area_sqkm forest_area_2016
    FROM forestation f
    WHERE f.year=2016 AND f.forest_area_sqkm IS NOT NULL
    )
SELECT  y1990.country_name,
        y1990.region,
```

```
        ROUND(ABS(y2016.forest_area_2016 -
y1990.forest_area_1990)::NUMERIC)  decreased_amount
FROM forestation_1990 y1990
JOIN forestation_2016 y2016
  ON y1990.country_code = y2016.country_code
WHERE y1990.country_name != 'World'AND y2016.forest_area_2016 <
y1990.forest_area_1990
ORDER BY 3 DESC
LIMIT 5;
```

```
-- Finds top 5 countries with maximum percent decrease in forest area between
1990 and 2016.
WITH
    forestation_1990 AS
    (SELECT f.country_code,
            f.country_name,
            f.region,
            f.forest_percent forest_percent_1990
     FROM forestation f
     WHERE f.year=1990 AND f.forest_percent IS NOT NULL
    ),
    forestation_2016 AS
    (SELECT f.country_code,
            f.country_name,
            f.region,
            f.forest_percent forest_percent_2016
    FROM forestation f
    WHERE f.year=2016 AND f.forest_percent IS NOT NULL
    )
SELECT  y1990.country_name,
        y1990.region,
        ROUND(((y2016.forest_percent_2016 - y1990.forest_percent_1990) /
y1990.forest_percent_1990 * 100)::NUMERIC,2) decreased_percent
FROM forestation_1990 y1990
JOIN forestation_2016 y2016
  ON y1990.country_code = y2016.country_code
WHERE y1990.country_name != 'World' AND y1990.forest_percent_1990 != 0
ORDER BY 3 ASC
LIMIT 5;
```

Queries of Part 3 – Section C:

```
-- Counts the countries grouped by forestation percent quartiles in 2016.
WITH quartiles AS
    (SELECT
        f.country_name,
```

```
        f.forest_percent,
        CASE WHEN f.forest_percent <= 25 THEN 1
             WHEN f.forest_percent <= 50 THEN 2
             WHEN f.forest_percent <= 75 THEN 3
             ELSE 4
        END quartile_no
    FROM forestation f
    WHERE f.year=2016 AND f.forest_percent IS NOT NULL
    )
SELECT q.quartile_no, COUNT(*) num_countries
FROM quartiles q
GROUP BY q.quartile_no
ORDER BY 1;
```

```
-- Finds the countries in quartile no. 4 of forestation percent quartiles in
2016.
WITH quartiles AS
    (SELECT
        f.country_name,
        f.region,
        f.forest_percent,
        CASE WHEN f.forest_percent <= 25 THEN 1
             WHEN f.forest_percent <= 50 THEN 2
             WHEN f.forest_percent <= 75 THEN 3
             ELSE 4
        END quartile_no
    FROM forestation f
    WHERE f.year=2016 AND f.forest_percent IS NOT NULL
    )
SELECT q.country_name, q.region, q.forest_percent
FROM quartiles q
WHERE q.quartile_no = 4
ORDER BY q.forest_percent DESC;
```

Queries of Part 4:

```
-- Finds the annually decreased forest area of the world between 1990 and 2016.
SELECT
       sub.year,
       sub.forest_area - LAG(sub.forest_area) OVER (ORDER BY sub.year) AS
forest_area_difference
FROM
( SELECT f.region, f.year,
         ROUND(SUM(f.forest_area_sqkm)) AS forest_area
  FROM forestation f
  WHERE f.region='World'
```

```
  GROUP BY f.region, f.year
  ORDER BY 1,2
) sub;
```