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 **3.2**%.

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 **1279999.98**).

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 and Carribean**, with **46.16**%, and the region with the lowest relative forestation was **Middle East and 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 and Carribean**, with **51.03**%, and the region with the lowest relative forestation was **Middle East and North Africa**, with **1.78%** forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
1.East Asia & Pacific 2.Latin America & Caribbean 3.Europe & Central Asia	25.78 51.03 37.28	26.36 46.16 38.04
4.Sub Saharan Africa 5.South Asia	30.67 16.51	28.79 17.51
6.North America 7.Middle East & North Africa 8.World	35.65 1.78 32.42	36.04 2.07 31.38

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**, 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 **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
1.Brazil 2.Indonesia	Latin America & Caribbean East Asia & Pacific	541510 282193.98
3.Myanmar 4.Nigeria	East Asia & Pacific Sub Saharan Africa	107234.003 106506.009
5.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:

Country	Region	Pct Forest Area Change
1.Togo 2.Nigeria	Sub Saharan Africa Sub Saharan Africa	75.45 61.80
3.Uganda 4.Mauritania	Sub Saharan Africa Sub Saharan Africa	59.13 46.75
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**. 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
First Quartile	85
Second Quartile	72
Third Quartile	38
Fourth Quartile	9

The largest number of countries in 2016 were found in the **First** quartile.

There were **85** 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
1.Suriname 2.Micronesia,Fed.Sts. 3.Gabon	Latin America & Caribbean East Asia & Pacific Sub Saharan Africa	98.26 91.86 90.04
4.Seychelles 5.Palau 6.American Samoa	Sub Saharan Africa East Asia & Pacific East Asia & Pacific	88.41 87.61 87.50
8.Guyana 9.Lao PDR 10.Solomon Islands	Latin America & Caribbean East Asia & Pacific East Asia & Pacific	83.90 82.11 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?

From the world bank data I learned that the world lost 3.2% of total forest area in a span of 16 years(1990_2016).From table 2.1 it is obvious that Latin America & Caribbean(51.03% in 1990 & 46.16% in 2016) lost the highest forest area followed by Sub Saharan Africa(30.67% in 1990 & 28.79 in 2016). Among the top five countries that decreased in forest area, four of them fall in Sub Saharan Africa.

However China, theUnited States and Iceland have shown an increase in forest area. China has drastically increased by 527229.06 sqkm and Iceland being a smaller country has increased in forest area by 213.66 %. Suriname,Micronesia,Fed Sts,Gabon,Seychelles,Palau,American Samoa,Guyana,Lao PDR,Solomom have a total percent of forest area greater than 75%.

Which countries should we focus on over others?

Many countries in the sub Saharan Africa needs focus like Togo Nigeria,Uganda,.Mauritania because they lost the highest percentage of forest area. Brazil,Indonesia,Myanmar and Tanzania need attention too as they lost the highest forest area.

APPENDIX: SQL Queries Used

CREATING A VIEW:

```
DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation
AS
SELECT  f.country_code AS f_country_code,
       f.country_name AS f_country_name,
       f.year AS f_year,
       f.forest_area_sqkm AS f_forest_area_sqkm,
      (l.total_area_sq_mi*2.59) AS l_total_area_sqkm,
       (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100
                AS percent_forest,
        r.region AS r_region,
        r.income_group AS r_income_group
        FROM forest_area f
 JOIN  land_area l
 ON    f.country_code=l.country_code
```

```
 AND   f.year=l.year
JOIN   regions r
ON     f.country_code=r.country_code;
```

GLOBAL SITUATION:

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

```
SELECT  SUM(f_forest_area_sqkm) AS Total_forest_area
FROM    forestation
WHERE   f_year=1990
AND     f_country_name='World';
```

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

```
SELECT SUM(f_forest_area_sqkm) AS Total_forest_area
FROM forestation
WHERE f_year=2016
AND f_country_name='World';
```

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

```
 SELECT ( (SELECT Sum(f_forest_area_sqkm) AS Total_forest_area
         FROM   forestation
         WHERE  f_year = 1990
                AND f_country_name = 'World') - (SELECT
                Sum(f_forest_area_sqkm) AS Total_forest_area
                                      FROM   forestation
                                      WHERE  f_year = 2016
                                             AND f_country_name =
                                                 'World')
       ) AS change_in_forest_area
```

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

```
 SELECT ( (SELECT Sum(f_forest_area_sqkm) AS Total_forest_area
         FROM   forestation
         WHERE  f_year = 2016
                AND f_country_name = 'World') - (SELECT
                Sum(f_forest_area_sqkm) AS Total_forest_area
                                      FROM   forestation
                                      WHERE  f_year = 1990
```

```
                                        AND f_country_name =
                                            'World')
    ) * 100 / (SELECT Sum(f_forest_area_sqkm) AS Total_forest_area
            FROM   forestation
            WHERE  f_year = 1990
                AND f_country_name = 'World') AS percent_change;
```

(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 f_country_name,
     Sum(l_total_area_sqkm)
FROM   forestation
WHERE  f_year = 2016
GROUP  BY 1
HAVING Sum(l_total_area_sqkm) <= ( (SELECT Sum(f_forest_area_sqkm) AS
                                       Total_forest_area
                                FROM   forestation
                                WHERE  f_year = 1990
                                    AND f_country_name = 'World') -
                                   (SELECT Sum(f_forest_area_sqkm) AS
                                       Total_forest_area
                                    FROM   forestation
                                    WHERE  f_year = 2016
                                        AND f_country_name = 'World'))

ORDER  BY 2 DESC
LIMIT  1
```

REGIONAL

(a)What was the percent forest of the entire world in 2016?

```
 SELECT Round(( SUM(f_forest_area_sqkm) :: NUMERIC / SUM(l_total_area_sqkm) ::
                NUMERIC * 100 ), 2) AS forest_percent,
     r_region,
     f_year
 FROM   forestation
 WHERE  f_year = 2016
 GROUP  BY r_region,
        f_year
 ORDER  BY 1 DESC ;
```

(b) What was the percent forest of the entire world in 1990?

```
SELECT Round(( SUM(f_forest_area_sqkm) :: NUMERIC / SUM(l_total_area_sqkm) ::
                NUMERIC * 100 ), 2) AS forest_percent,
    r_region,
    f_year
FROM   forestation
WHERE  f_year = 1990
GROUP  BY r_region,
       f_year
ORDER  BY 1 DESC ;
```

(c) Based on the table you created, which regions of the world decreased in forest area from 1990 to 2016?

```
WITH forest_percentage_1990
  AS (SELECT Round(( SUM(f_forest_area_sqkm) ::
                NUMERIC / SUM(l_total_area_sqkm) ::
                      NUMERIC * 100 ), 2) AS forest_percent_1990,
          r_region
      FROM   forestation
      WHERE  f_year = 1990 AND r_region NOT LIKE 'World'
      GROUP  BY r_region
      ORDER  BY 1),
  forest_percentage_2016
  AS (SELECT Round(( SUM(f_forest_area_sqkm) ::
                NUMERIC / SUM(l_total_area_sqkm) ::
                      NUMERIC * 100 ), 2) AS forest_percent_2016,
          r_region
      FROM   forestation
      WHERE  f_year = 2016 AND r_region NOT LIKE 'World'
      GROUP  BY r_region
      ORDER  BY 1)
SELECT f1.forest_percent_1990,
    f2.forest_percent_2016,
    f1.r_region,
    ( f1.forest_percent_1990 - f2.forest_percent_2016 ) AS change_percent
FROM   forest_percentage_1990 f1
    join forest_percentage_2016 f2
      ON f1.r_region = f2.r_region
ORDER  BY change_percent DESC;
```

COUNTRY LEVEL

(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?

```
 WITH forest_area_1990
   AS (SELECT Sum(f_forest_area_sqkm) AS forest_area_1990,
              f_country_name,r_region
       FROM   forestation
       WHERE  f_year = 1990
              AND f_forest_area_sqkm IS NOT NULL
              AND f_country_name NOT LIKE 'World'
       GROUP  BY f_country_name,r_region),
   forest_area_2016
   AS (SELECT Sum(f_forest_area_sqkm) AS forest_area_2016,
              f_country_name,r_region
       FROM   forestation
       WHERE  f_year = 2016
              AND f_forest_area_sqkm IS NOT NULL
              AND f_country_name NOT LIKE 'World'
       GROUP  BY f_country_name,r_region)
SELECT f1.forest_area_1990,
      f2.forest_area_2016,f1.r_region,
      f1.f_country_name,
      ( f1.forest_area_1990 - f2.forest_area_2016 ) AS change_area
FROM   forest_area_1990 f1
      JOIN forest_area_2016 f2
        ON f1.f_country_name = f2.f_country_name
ORDER  BY change_area DESC;
```

(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?

```
 WITH forest_area_1990 AS
(
      SELECT SUM(f_forest_area_sqkm) AS forest_area_1990,
            f_country_name,
            r_region
```

```
      FROM   forestation
      WHERE  f_year = 1990 AND f_country_name NOT LIKE 'World'
      AND    f_forest_area_sqkm IS NOT NULL
            GROUP BY f_country_name,r_region), forest_area_2016 AS
(
      SELECT SUM(f_forest_area_sqkm )AS forest_area_2016,
            f_country_name,
            r_region
      FROM   forestation
      WHERE  f_year = 2016 AND f_country_name NOT LIKE 'World'
      AND    f_forest_area_sqkm IS NOT NULL
            GROUP BY f_country_name,r_region) SELECT   forest_area_1990,
       forest_area_2016,
       f1.f_country_name,
       f1.r_region,
       Round((((  forest_area_1990)-(forest_area_2016))*100/forest_area_1990)::numeric,2) AS
change_percent
FROM     forest_area_1990 f1
JOIN     forest_area_2016 f2
ON       f1.f_country_name = f2.f_country_name
ORDER BY change_percent DESC limit 5;
```

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

```
            WITH t1  AS
    ( SELECT
 ((f_forest_area_sqkm)/(l_total_area_sqkm))*100 AS percent_forest
                FROM Forestation
  WHERE f_country_name != 'World' AND percent_forest IS NOT NULL
                    AND f_year=2016
                    ORDER BY 1 DESC),
          t2 AS (SELECT

                    t1.percent_forest,
                    CASE  WHEN percent_forest BETWEEN 0 AND 25 THEN 'First quartile'
              WHEN percent_forest BETWEEN 25 AND 50 THEN 'Second quartile'
              WHEN percent_forest BETWEEN 50 AND 75 THEN 'Third quartile'
              WHEN percent_forest BETWEEN 75 AND 100 THEN 'Fourth quartile'
             END AS quartiles

                    FROM t1 ORDER BY 1 DESC
               )
```

```
SELECT t2.quartiles,
       COUNT(t2.quartiles)
       FROM t2
       GROUP BY 1
       ORDER BY 2 DESC;
```

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

```
WITH t1
    AS (SELECT f_country_name,
               r_region,
               ( ( f_forest_area_sqkm ) / ( l_total_area_sqkm ) ) * 100 AS
                 percent_forest
        FROM   forestation
        WHERE  f_country_name != 'World'
               AND percent_forest IS NOT NULL
               AND f_year = 2016
        ORDER  BY 3 DESC),
    t2
    AS (SELECT f_country_name,
               r_region,
               t1.percent_forest,
               CASE
                 WHEN percent_forest BETWEEN 0 AND 25 THEN 'First quartile'
                 WHEN percent_forest BETWEEN 25 AND 50 THEN 'Second quartile'
                 WHEN percent_forest BETWEEN 50 AND 75 THEN 'Third quartile'
                 WHEN percent_forest BETWEEN 75 AND 100 THEN 'Fourth quartile'
               END AS quartiles
        FROM   t1
        ORDER  BY 3 DESC)
SELECT t2.f_country_name,
       r_region,
       Round(t2.percent_forest :: NUMERIC, 2) AS percent_forest,
       t2.quartiles
FROM   t2
WHERE  t2.quartiles = 'Fourth quartile'
```

```
ORDER  BY 1;
```

(e)

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

```
 WITH t1 AS
(
       SELECT   f_country_code,
              f_country_name,
              f_year,
              f_forest_area_sqkm,
              l_total_area_sqkm,
              ((f_forest_area_sqkm)/(l_total_area_sqkm))*100 AS percent_forest
       FROM     forestation
       WHERE    f_country_name != 'World'
       AND      f_forest_area_sqkm IS NOT NULL
       AND      l_total_area_sqkm IS NOT NULL
       AND      f_year=2016
       ORDER BY 6 DESC)
SELECT Count(t1.f_country_name)
FROM   t1
WHERE  t1.percent_forest >
     (
          SELECT t1.percent_forest
          FROM   t1
                              WHERE t1.f_country_name = 'United States')
```