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 km²** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 km²**, a loss of **1324449 km²**, or **3.208**%.

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 km²**).

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 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
World	32.42	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 **527229.062 km^2**. 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 km^2**, much lower than the figure for **China**.

United States and **China** 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 (km^2)
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:

Country	Region	Pct Forest Area Change
Togo	Sub-Saharan Africa	75.45
Nigeria	Sub-Saharan Africa	61.8
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
1	85
2	72
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 (fourth 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
American Samoa	East Asia & Pacific	87.5
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Palau	East Asia & Pacific	87.61
Seychelles	Sub-Saharan Africa	88.41
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26

4. RECOMMENDATIONS

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

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

  Just within the span of 16 years (2009 – 2016), the world has lost **3.208**% of total forest area, which is a very serious problem. To given an estimate, we have lost the

forest area slightly greater than the entire land area of **Peru.** From Table 3.1, we observe that region of **Latin America & Caribbean** is of serious concern because it has lost the highest forest area, and forest area lost is equal to **541510 km2**. Similarly, if we observe Table 3.2, we notice that out of the top five countries which has lost the highest percentage of their forest area, the top four countries belong to the **Sub-Saharan Africa** region. There are 85 countries (almost 40% of the total countries) in the world that has less than or equal to 25% of the total forest area, as concluded from Table 3.3. However, the picture is not all dark and gloomy, countries like China, Iceland, the United States, etc., have shown an increase in forest area from the year 1990 to 2016. Especially, China has dramatically increased its forest area by an amount of **527229.062 km2**. An even smaller country like Iceland has also increased its forest area by **213.66**% from 1990 to 2016. In Table 3.4, shows the countries which have a total percent of forest area >= 75%, and we .

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

1. Primary focus should on Nigeria because it is in top 5 countries which has lost highest forest area and highest percentange of forest area.
2. The focus should on countries like Brazil, Indonesia, Myanmar, and Tanzania because they have lost highest forest area.
3. Many countries in the region of Sub-Saharan Africa needs more attention because it has lost highest percentange of forest area.

5. Appendix: SQL queries used

Create a View called “forestation”

```
CREATE OR REPLACE VIEW forestation

AS

SELECT f.country_code AS forest_cc,

    f.country_name AS f_name,

    f.year AS f_year,

     f.forest_area_sqkm AS f_sq_km,
```

```
    l.total_area_sq_mi AS l_total_area_sq_mi,

    r.region AS r_region, r.income_group AS r_income_group,

     (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS perc_forest_area

FROM forest_area f

Join land_area l

ON f.country_code = l.country_code

JOIN regions r

ON l.country_code = r.country_code

WHERE f.year = l.year ORDER BY 1;
```

1. GLOBAL SITUATION

a. What was the total forest area (in sq km) of the world in 1990? Please keep in mind that you can use the country record denoted as “World" in the region table.

```
SELECT f.forest_area_sqkm

                FROM forest_area f

    WHERE f.country_name = 'World'

       AND f.year = 1990;
```

b. What was the total forest area (in sq km) of the world in 2016? Please keep in mind that you can use the country record in the table is denoted as “World.”

```
SELECT f.forest_area_sqkm
                FROM forest_area f
    WHERE f.country_name = 'World'
      AND f.year = 2016;
```

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

```
SELECT sub1.forest_area_sqkm - sub2.forest_area_sqkm AS
diff_forest_area_sq_km
   FROM (SELECT f.country_code AS cc, f.forest_area_sqkm
         FROM forest_area f
        WHERE f.country_name = 'World'
              AND f.year = 1990) AS sub1
   JOIN (SELECT f.country_code AS cc,f.forest_area_sqkm
              FROM forest_area f
        WHERE f.country_name = 'World'
              AND f.year = 2016) AS sub2
   ON sub1.cc = sub2.cc;
```

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

```
SELECT
((sub1.forest_area_sqkm-sub2.forest_area_sqkm)/sub1.forest_area_sqkm)*100
AS perc_change_fa

    FROM (SELECT f.country_code AS cc, f.forest_area_sqkm

          FROM forest_area f

         WHERE f.country_name = 'World'

               AND f.year = 1990) AS sub1

   JOIN (SELECT f.country_code AS cc,f.forest_area_sqkm

               FROM forest_area f

         WHERE f.country_name = 'World'

               AND f.year = 2016) AS sub2

   ON sub1.cc = sub2.cc;
```

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 l.country_name,

    l.total_area_sq_mi*2.59 AS total_area_sqkm,

    ABS((l.total_area_sq_mi*2.59)- (SELECT sub1.forest_area_sqkm -
               sub2.forest_area_sqkm AS diff_forest_area_sq_km

                         FROM (SELECT f.country_code AS cc, f.forest_area_sqkm

                                   FROM forest_area f
```

```
WHERE f.country_name = 'World'

AND f.year = 1990) AS sub1

JOIN (SELECT f.country_code AS cc,f.forest_area_sqkm

FROM forest_area f

WHERE f.country_name = 'World'

AND f.year = 2016) AS sub2

ON sub1.cc = sub2.cc)) AS diff_fa_la_sqkm

FROM land_area l

WHERE l.year = 2016

ORDER BY 3 LIMIT 1;
```

2. REGIONAL OUTLOOK

Create a table that shows the Regions and their percent forest area (sum of forest area divided by sum of land area) in 1990 and 2016.

```
CREATE OR REPLACE VIEW regional_distr

AS

SELECT r.region,

    l.year,

    SUM(f.forest_area_sqkm) total_forest_area_sqkm,
```

```
    SUM(l.total_area_sq_mi*2.59) AS total_area_sqkm,

    (SUM(f.forest_area_sqkm)/SUM(l.total_area_sq_mi*2.59))*100 AS
percent_fa_region

   FROM forest_area f

   JOIN land_area l

   ON f.country_code = l.country_code AND f.year = l.year

   JOIN regions r

   ON l.country_code = r.country_code

   GROUP BY 1,2

   ORDER BY 1,2;
```

a.1. What was the percent forest of the entire world in 2016?, and which had the LOWEST, to 2 decimal places?

```
SELECT ROUND(CAST(percent_fa_region AS numeric),2) AS percent_fa_region

          FROM regional_distr

  WHERE year = 2016 AND region = 'World';
```

a.2. Which region had the HIGHEST percent forest in 2016, to 2 decimal places?

```
SELECT region,
```

```
    ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,

    ROUND(CAST(percent_fa_region AS NUMERIC),2) AS percent_fa_region

    FROM regional_distr

    WHERE ROUND(CAST(percent_fa_region AS NUMERIC),2) = (SELECT MAX(

                                        ROUND(

                                            CAST(percent_fa_region AS
                                                numeric),2

                                        )

                                    ) AS max_percent

                                                        FROM
regional_distr

                                    WHERE year = 2016

                                )

        AND year=2016;
```

a.3. Which region had the LOWEST percent forest in 2016, to 2 decimal places?

```
SELECT region,

    ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,

    ROUND(CAST(percent_fa_region AS NUMERIC),2) AS percent_fa_region
```

```
    FROM regional_distr
    WHERE ROUND(CAST(percent_fa_region AS NUMERIC),2) = (SELECT MIN(
                                                ROUND(
                                                    CAST(percent_fa_region AS numeric),2
                                                )
                                                ) AS max_percent
                                                                    FROM
regional_distr
                                                WHERE year = 2016
                                            )
        AND year = 2016;
```

b.1. What was the percent forest of the entire world in 1990?

```
SELECT ROUND(CAST(percent_fa_region AS numeric),2) AS percent_fa_region
            FROM regional_distr
    WHERE year = 1990 AND region = 'World';
```

b.2. Which region had the HIGHEST percent forest in 1990, to 2 decimal places?

```
    SELECT region,
        ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,
```

```
        ROUND(CAST(percent_fa_region AS NUMERIC),2) AS percent_fa_region

        FROM regional_distr

        WHERE ROUND(CAST(percent_fa_region AS NUMERIC),2) = (SELECT MAX(

                                                ROUND(

                                                    CAST(percent_fa_region AS
numeric),2

                                                )

                                                ) AS max_percent

                                                        FROM
regional_distr

                                                WHERE year = 1990

                                                )

            AND year=1990;
```

b.3. Which had the LOWEST percent forest in 1990, to 2 decimal place ?

```
   SELECT region,

        ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,

        ROUND(CAST(percent_fa_region AS NUMERIC),2) AS percent_fa_region

        FROM regional_distr
```

```
        WHERE ROUND(CAST(percent_fa_region AS NUMERIC),2) = (SELECT MIN(
                                                ROUND(
                                                    CAST(percent_fa_region AS
numeric),2
                                                )
                                                ) AS max_percent
                                                                FROM
regional_distr
                                                WHERE year = 1990
                                            )
            AND year = 1990;
```

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

```
WITH table1990 AS (SELECT * FROM regional_distr WHERE year =1990),
        table2016 AS (SELECT * FROM regional_distr WHERE year = 2016)
SELECT table1990.region,
    ROUND(CAST(table1990.percent_fa_region AS NUMERIC),2) AS fa_1990,
    ROUND(CAST(table2016.percent_fa_region AS NUMERIC),2) AS fa_2016
  FROM table1990 JOIN table2016 ON table1990.region = table2016.region
```

```
   WHERE table1990.percent_fa_region > table2016.percent_fa_region;
```

3. COUNTRY-LEVEL DETAIL

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 table1990 AS (SELECT f.country_code,

                  f.country_name,

                  f.year,

                  f.forest_area_sqkm

                      FROM forest_area f

                WHERE f.year = 1990 AND f.forest_area_sqkm IS NOT NULL AND
f.country_name != 'World'

                ),

    table2016 AS (SELECT f.country_code,

                   f.country_name,

                   f.year,

                   f.forest_area_sqkm

                       FROM forest_area f

                WHERE f.year = 2016 AND f.forest_area_sqkm IS NOT NULL AND
f.country_name != 'World'
```

```
                )



SELECT table1990.country_code,

    table1990.country_name,

    r.region,

    table1990.forest_area_sqkm AS fa_1990_sqkm,

    table2016.forest_area_sqkm AS fa_2016_sqkm,

    table1990.forest_area_sqkm-table2016.forest_area_sqkm AS diff_fa_sqkm

  FROM table1990

  JOIN table2016

  ON table1990.country_code = table2016.country_code

  AND (table1990.forest_area_sqkm IS NOT NULL AND
table2016.forest_area_sqkm IS NOT NULL)

  JOIN regions r ON table2016.country_code = r.country_code

  ORDER BY 6 DESC

  LIMIT 5;
```

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 table1990 AS (SELECT f.country_code,
```

```
                f.country_name,

                f.year,

                f.forest_area_sqkm

                    FROM forest_area f

                WHERE f.year = 1990 AND f.forest_area_sqkm IS NOT NULL AND
f.country_name != 'World'

            ),

    table2016 AS (SELECT f.country_code,

                 f.country_name,

                 f.year,

                 f.forest_area_sqkm

                    FROM forest_area f

                WHERE f.year = 2016 AND f.forest_area_sqkm IS NOT NULL AND
f.country_name != 'World'

            )

 SELECT table1990.country_code,

      table1990.country_name,

      r.region,

      table1990.forest_area_sqkm AS fa_1990_sqkm,
```

```
    table2016.forest_area_sqkm AS fa_2016_sqkm,

    table1990.forest_area_sqkm-table2016.forest_area_sqkm AS diff_fa_sqkm,

    ABS(ROUND(CAST(((table2016.forest_area_sqkm-
table1990.forest_area_sqkm)/table1990.forest_area_sqkm*100) AS
NUMERIC),2)) AS perc_change

  FROM table1990

  JOIN table2016

  ON table1990.country_code = table2016.country_code

  AND (table1990.forest_area_sqkm IS NOT NULL AND
table2016.forest_area_sqkm IS NOT NULL) JOIN regions r ON
table2016.country_code = r.country_code

  ORDER BY ROUND(CAST(((table2016.forest_area_sqkm-
table1990.forest_area_sqkm)/table1990.forest_area_sqkm*100) AS
NUMERIC),2)

  LIMIT 5;
```

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

```
WITH table1 AS (SELECT f.country_code,

            f.country_name,

            f.year,

            f.forest_area_sqkm,
```

```
                l.total_area_sq_mi*2.59 AS total_area_sqkm,

                (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS perc_fa

                FROM forest_area f

                JOIN land_area l

                ON f.country_code = l.country_code

                AND (f.country_name != 'World' AND f.forest_area_sqkm IS NOT
NULL AND l.total_area_sq_mi IS NOT NULL)

                AND (f.year=2016 AND l.year = 2016)

                ORDER BY 6 DESC

            ),

    table2 AS (SELECT table1.country_code,

                table1.country_name,

                 table1.year,

                 table1.perc_fa,

                 CASE WHEN table1.perc_fa >= 75 THEN 4

                    WHEN table1.perc_fa < 75 AND table1.perc_fa >= 50 THEN 3

                    WHEN table1.perc_fa < 50 AND table1.perc_fa >=25 THEN 2

                    ELSE 1
```

```
                END AS percentile
                FROM table1 ORDER BY 5 DESC
            )

SELECT table2.percentile,
    COUNT(table2.percentile)
    FROM table2
    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 table1 AS (SELECT f.country_code,
                f.country_name,
                f.year,
                f.forest_area_sqkm,
                l.total_area_sq_mi*2.59 AS total_area_sqkm,
                 (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS perc_fa
                 FROM forest_area f
```

```
                JOIN land_area l

                ON f.country_code = l.country_code

                AND (f.country_name != 'World' AND f.forest_area_sqkm IS NOT
NULL AND l.total_area_sq_mi IS NOT NULL)

                AND (f.year=2016 AND l.year = 2016)

                ORDER BY 6 DESC

            ),

    table2 AS (SELECT table1.country_code,

                table1.country_name,

                 table1.year,

                 table1.perc_fa,

                 CASE WHEN table1.perc_fa >= 75 THEN 4

                    WHEN table1.perc_fa < 75 AND table1.perc_fa >= 50 THEN 3

                    WHEN table1.perc_fa < 50 AND table1.perc_fa >=25 THEN 2

                    ELSE 1

                 END AS percentile

                 FROM table1 ORDER BY 5 DESC

            )
```

```
SELECT table2.country_name,
    r.region,
    ROUND(CAST(table2.perc_fa AS NUMERIC),2) AS perc_fa,
    table2.percentile
    FROM table2
    JOIN regions r
    ON table2.country_code = r.country_code
    WHERE table2.percentile = 4
    ORDER BY 1;
```

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

```
With table1 AS (SELECT f.country_code,
                f.country_name,
                f.year,
                f.forest_area_sqkm,
                l.total_area_sq_mi*2.59 AS total_area_sqkm,
                 (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS perc_fa
                 FROM forest_area f
```

```
                JOIN land_area l

                ON f.country_code = l.country_code

                AND (f.country_name != 'World' AND f.forest_area_sqkm IS NOT
NULL AND l.total_area_sq_mi IS NOT NULL)

                AND (f.year=2016 AND l.year = 2016)

                ORDER BY 6 DESC

            )

SELECT COUNT(table1.country_name)

    FROM table1

    WHERE table1.perc_fa > (SELECT table1.perc_fa

                        FROM table1

                        WHERE table1.country_name = 'United States'

                    )
```