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 **41,282,694.4 sq km** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9 sq km**, a loss of **1,324,449 sq km**, or **3.2**%.

The forest area lost over this time period is slightly more than the entire land area of **Australia** listed for the year 2016 (which is **1,250,590 sq 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 Percentage	2016 Forest Percentage
World	32.42%	31.38%
Sub-Saharan Africa	30.67%	28.79%
Latin America & Caribbean	51.03%	46.16%

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Sub-Saharan Africa** (dropped from **30.67%** to **28.79%**) and **Latin America & Caribbean** (**51.03%** to **46.16%**). 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 **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

Brazil	Latin America & Caribbean	541,510
Indonesia	East Asia & Pacific	282,194
Nigeria	Sub-Saharan Africa	106,506

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	85
2	72

3	38
4	9

The largest number of countries in 2016 were found in the **1** 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
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Suriname	Latin America & Caribbean	98.26
Gabon	Sub-Saharan Africa	90.04

4. RECOMMENDATIONS

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

- *The forest area of world decreased from 1990-2016.*
  There are 2 regions we need to focus on, **Sub-Saharan Africa** (dropped from **30.67%** to **28.79%**) and **Latin America & Caribbean** (**51.03%** to **46.16%**).
  All other regions are increased in forest area.
- There are 5 countries we need to focus on.
  Togo, **Nigeria**, **Uganda**, **Mauritania, Honduras**.

5. APPENDIX: SQL Queries Used

SETUP

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
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,
          r.region,
          r.income_group
   FROM   forest_area AS f
          JOIN land_area AS l
```

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

1. GLOBAL SITUATION

- ```
  SELECT forest_area_sqkm AS world_forest_area_1990
  FROM   forestation
  WHERE  country_name = 'World'
         AND year = 1990;
  ```

- ```
  SELECT forest_area_sqkm AS world_forest_area_2016
  FROM   forestation
  WHERE  country_name = 'World'
         AND year = 2016
  ```

- ```
  WITH world_1990
       AS (SELECT total_forest_area_sqkm AS world_forest_area_1990
           FROM   forestation
           WHERE  country_name = 'World'
                  AND year = 1990),
       world_2016
       AS (SELECT total_forest_area_sqkm AS world_forest_area_2016
           FROM   forestation
           WHERE  country_name = 'World'
                  AND year = 2016)
  SELECT world_1990.world_forest_area_1990 - world_2016.world_forest_area_2016 AS
         forest_area_change
  FROM   world_1990,
         world_2016
  ```

- ```
  WITH world_1990
       AS (SELECT total_forest_area_sqkm AS world_forest_area_1990
           FROM   forestation
           WHERE  country_name = 'World'
                  AND year = 1990),
       world_2016
       AS (SELECT total_forest_area_sqkm AS world_forest_area_2016
           FROM   forestation
           WHERE  country_name = 'World'
                  AND year = 2016)
  SELECT 100 * Round(Cast(( world_2016.world_forest_area_2016 -
                                       world_1990.world_forest_area_1990 ) /
  world_1990.world_forest_area_1990 AS
  NUMERIC)
  , 4) AS forest_area_change
  FROM   world_1990,
         world_2016
  ```

- ```
  WITH world_1990
       AS (SELECT total_forest_area_sqkm AS world_forest_area_1990
           FROM   forestation
           WHERE  country_name = 'World'
                  AND year = 1990),
       world_2016
  ```
  ```

```
      AS (SELECT total_forest_area_sqkm AS world_forest_area_2016
          FROM   forestation
          WHERE  country_name = 'World'
                 AND year = 2016)
SELECT country_name,
       year,
       Sum(total_forest_area_sqkm) AS total_forest_area_in_sqkm
FROM   forestation
WHERE  year = 2016
       AND total_forest_area_sqkm IS NOT NULL
       AND country_name != 'World'
GROUP  BY country_name,
          year
ORDER  BY total_forest_area_in_sqkm DESC
```

2. REGIONAL OUTLOOK

- ```
  WITH world_1990
       AS (SELECT region,
                  Round(Cast(Sum(total_forest_area_sqkm) / Sum(total_area_sqkm) *
                             100
                             AS
                             NUMERIC),
                  2) AS percent_forest_area_1990
           FROM   forestation
           WHERE  year = 1990
           GROUP  BY region
           ORDER  BY percent_forest_area_1990),
       world_2016
       AS (SELECT region,
                  Round(Cast(Sum(total_forest_area_sqkm) / Sum(total_area_sqkm) *
                             100
                             AS
                             NUMERIC),
                  2) AS percent_forest_area_2016
           FROM   forestation
           WHERE  year = 2016
           GROUP  BY region
           ORDER  BY percent_forest_area_2016)
  SELECT *
  FROM   world_2016
  ```

- ```
  WITH world_1990
       AS (SELECT region,
                  Round(Cast(Sum(total_forest_area_sqkm) / Sum(total_area_sqkm) *
                             100
                             AS
                             NUMERIC),
                  2) AS percent_forest_area_1990
           FROM   forestation
           WHERE  year = 1990
           GROUP  BY region
           ORDER  BY percent_forest_area_1990),
       world_2016
       AS (SELECT region,
                  Round(Cast(Sum(total_forest_area_sqkm) / Sum(total_area_sqkm) *
                             100
                             AS
  ```

```
                        NUMERIC),
                2) AS percent_forest_area_2016
          FROM   forestation
          WHERE  year = 2016
          GROUP  BY region
          ORDER  BY percent_forest_area_2016)
SELECT *
FROM   world_1990
```

- ```
  WITH world_1990
       AS (SELECT region,
                  Round(Cast(Sum(total_forest_area_sqkm) / Sum(total_area_sqkm) *
                             100
                             AS
                             NUMERIC),
                  2) AS percent_forest_area_1990
             FROM   forestation
             WHERE  year = 1990
             GROUP  BY region
             ORDER  BY percent_forest_area_1990),
       world_2016
       AS (SELECT region,
                  Round(Cast(Sum(total_forest_area_sqkm) / Sum(total_area_sqkm) *
                             100
                             AS
                             NUMERIC),
                  2) AS percent_forest_area_2016
             FROM   forestation
             WHERE  year = 2016
             GROUP  BY region
             ORDER  BY percent_forest_area_2016)
  SELECT world_1990.region,
         world_1990.percent_forest_area_1990,
         world_2016.percent_forest_area_2016,
         CASE
           WHEN world_1990.percent_forest_area_1990 >
                world_2016.percent_forest_area_2016
         THEN 'TRUE'
           WHEN world_1990.percent_forest_area_1990 <
                world_2016.percent_forest_area_2016
         THEN 'FALSE'
           ELSE 'FALSE'
         END AS is_decreased
  FROM   world_2016
         JOIN world_1990
           ON world_2016.region = world_1990.region
  ```

3. Country-Level Detail

- ```
  WITH forest_area_1990 AS
  (
         SELECT region,
                country_name,
                total_forest_area_sqkm
         FROM   forestation
         WHERE  year = 1990
         AND    total_forest_area_sqkm IS NOT NULL), forest_area_2016 AS
  ```

```
(
       SELECT country_name,
              total_forest_area_sqkm
       FROM   forestation
       WHERE  year = 2016
       AND    total_forest_area_sqkm IS NOT NULL)
SELECT   forest_area_1990.country_name,
         forest_area_1990.region,
         forest_area_1990.total_forest_area_sqkm
                                  AS forest_area_1990,
         forest_area_2016.total_forest_area_sqkm
                                  AS forest_area_2016,
         Round(Cast(forest_area_1990.total_forest_area_sqkm - forest_area_2016.tot
al_forest_area_sqkm AS NUMERIC), 2) AS forest_area_decrease
FROM     forest_area_1990
JOIN     forest_area_2016
ON       forest_area_1990.country_name = forest_area_2016.country_name
WHERE    forest_area_1990.country_name != 'World'
ORDER BY forest_area_decrease limit 5
```

- ```
  WITH forest_area_1990 AS
  (
         SELECT region,
                country_name,
                total_forest_area_sqkm
         FROM   forestation
         WHERE  year = 1990
         AND    total_forest_area_sqkm IS NOT NULL), forest_area_2016 AS
  (
         SELECT country_name,
                total_forest_area_sqkm
         FROM   forestation
         WHERE  year = 2016
         AND    total_forest_area_sqkm IS NOT NULL)
  SELECT   forest_area_1990.country_name,
           region,
           forest_area_1990.total_forest_area_sqkm

    AS forest_area_1990,
           forest_area_2016.total_forest_area_sqkm

    AS forest_area_2016,
           100 * Round(Cast((forest_area_1990.total_forest_area_sqkm - forest_area_2
  016.total_forest_area_sqkm)/forest_area_1990.total_forest_area_sqkm AS NUMERIC), 4
  ) AS forest_area_percent_decrease_change
  FROM     forest_area_1990
  JOIN     forest_area_2016
  ON       forest_area_1990.country_name = forest_area_2016.country_name
  WHERE    forest_area_1990.country_name != 'World'
  ORDER BY forest_area_percent_decrease_change limit 5
  ```

- ```
  WITH forest_area_1990 AS
  (
         SELECT region,
  ```

```
              country_name,
              total_forest_area_sqkm
       FROM   forestation
       WHERE  year = 1990
       AND    total_forest_area_sqkm IS NOT NULL), forest_area_2016 AS
(
       SELECT country_name,
              total_forest_area_sqkm
       FROM   forestation
       WHERE  year = 2016
       AND    total_forest_area_sqkm IS NOT NULL)
SELECT   forest_area_1990.country_name,
         forest_area_1990.region,
         forest_area_1990.total_forest_area_sqkm
                                  AS forest_area_1990,
         forest_area_2016.total_forest_area_sqkm
                                  AS forest_area_2016,
         Round(Cast(forest_area_1990.total_forest_area_sqkm - forest_area_2016.tot
al_forest_area_sqkm AS NUMERIC), 2) AS forest_area_decrease
FROM     forest_area_1990
JOIN     forest_area_2016
ON       forest_area_1990.country_name = forest_area_2016.country_name
WHERE    forest_area_1990.country_name != 'World'
ORDER BY forest_area_decrease DESC limit 5
```

- ```
  WITH forest_area_1990 AS
  (
         SELECT region,
                country_name,
                total_forest_area_sqkm
         FROM   forestation
         WHERE  year = 1990
         AND    total_forest_area_sqkm IS NOT NULL), forest_area_2016 AS
  (
         SELECT country_name,
                total_forest_area_sqkm
         FROM   forestation
         WHERE  year = 2016
         AND    total_forest_area_sqkm IS NOT NULL)
  SELECT   forest_area_1990.country_name,
           region,
           forest_area_1990.total_forest_area_sqkm

    AS forest_area_1990,
           forest_area_2016.total_forest_area_sqkm

    AS forest_area_2016,
           100 * Round(Cast((forest_area_1990.total_forest_area_sqkm - forest_area_2
  016.total_forest_area_sqkm)/forest_area_1990.total_forest_area_sqkm AS NUMERIC), 4
  ) AS forest_area_percent_decrease_change
  FROM     forest_area_1990
  JOIN     forest_area_2016
  ON       forest_area_1990.country_name = forest_area_2016.country_name
  WHERE    forest_area_1990.country_name != 'World'
  ORDER BY forest_area_percent_decrease_change DESC limit 5
  ```
  ```

- ```
  WITH total_forest_land_area2016
       AS (SELECT country_name,
                  region,
                  Sum(total_forest_area_sqkm) AS total_forest_area_sqkm,
                  Sum(total_area_sqkm)        AS total_land_area_sqkm
           FROM   forestation
           WHERE  year = 2016
                  AND total_forest_area_sqkm IS NOT NULL
                  AND total_area_sqkm IS NOT NULL
                  AND country_name <> 'World'
           GROUP  BY country_name,
                     region),
       quartiles_totalforest_2016
       AS (SELECT country_name,
                  region,
                  Round(Cast(( total_forest_area_sqkm / total_land_area_sqkm ) *
                             100 AS
                             NUMERIC),
                  2)  AS percent_forestation,
                  CASE
                    WHEN ( total_forest_area_sqkm / total_land_area_sqkm ) * 100
                         BETWEEN 0
                         AND 25
                  THEN '1'
                    WHEN ( total_forest_area_sqkm / total_land_area_sqkm ) * 100
                         BETWEEN
                         25 AND 50
                  THEN '2'
                    WHEN ( total_forest_area_sqkm / total_land_area_sqkm ) * 100
                         BETWEEN
                         50 AND 75
                  THEN '3'
                    ELSE '4'
                  END AS quartile
           FROM   total_forest_land_area2016)
  SELECT quartile,
         Count(1) AS number_of_cities
  FROM   quartiles_totalforest_2016
  GROUP  BY 1
  ORDER  BY 1
  ```

- ```
  WITH total_forest_land_area2016
       AS (SELECT country_name,
                  region,
                  Sum(total_forest_area_sqkm) AS total_forest_area_sqkm,
                  Sum(total_area_sqkm)        AS total_land_area_sqkm
           FROM   forestation
           WHERE  year = 2016
                  AND total_forest_area_sqkm IS NOT NULL
                  AND total_area_sqkm IS NOT NULL
                  AND country_name <> 'World'
           GROUP  BY country_name,
                     region),
       quartiles_totalforest_2016
       AS (SELECT country_name,
                  region,
                  Round(Cast(( total_forest_area_sqkm / total_land_area_sqkm ) *
                             100 AS
                             NUMERIC),
  ```

```
                2)  AS percent_forestation,
                CASE
                  WHEN ( total_forest_area_sqkm / total_land_area_sqkm ) * 100
                       BETWEEN 0
                       AND 25
                THEN '1'
                  WHEN ( total_forest_area_sqkm / total_land_area_sqkm ) * 100
                       BETWEEN
                       25 AND 50
                THEN '2'
                  WHEN ( total_forest_area_sqkm / total_land_area_sqkm ) * 100
                       BETWEEN
                       50 AND 75
                THEN '3'
                  ELSE '4'
                END AS quartile
         FROM   total_forest_land_area2016)
SELECT Count(country_name) AS numbe_of_countries
FROM   quartiles_totalforest_2016
WHERE  percent_forestation > (SELECT percent_forestation
                              FROM   quartiles_totalforest_2016
                              WHERE  country_name = 'United States')
```