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 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 3.21%.

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 1,279,999.99 sq km).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 31.4%. 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 32.4%. 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
Latin America & Caribbean	51.03	46.16
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 527,229.06 sq 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 United States, but it only saw an increase of 79,200 sq km, 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 2.14% 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	-282,193.9844
Myanmar	East Asia & Pacific	-107,234.0039
Nigeria	Sub-Saharan Africa	-106,506.00098
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	0.75
Nigeria	Sub-Saharan Africa	0.62
Uganda	Sub-Saharan Africa	0.59
Mauritania	Sub-Saharan Africa	0.47
Honduras	Latin America & Caribbean	0.45

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
0-25	85
25-50	72
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	98.2577
Micronesia, Fed. Sts.	East Asia & Pacific	91.8572
Gabon	Sub-Saharan Africa	90.0376

4. 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?*

Based on the data, I would recommend that we focus on the regions of Sub-Saharan Africa and Latin America & Caribbean, as they are the only regions of the world that decreased in forest area from 1990 to 2016. All other regions increased in total forest area. However, the drop in forest area in these two regions was so large, the percent forest area of the entire world decreased over this time period. If we can slow or stop deforestation in these regions, we may be able to increase the total forest area of the world in the coming years.

To decide which specific countries we should focus on, we should prioritize total forest area over percentage, as total forest area will have a greater effect on global forestation overall. For this reason, I would recommend focusing on Brazil, Indonesia, Myanmar, Nigeria, and Tanzania, as they have lost the most total forest area since 1990. Brazil alone has lost 541,510 sq km since 1990, accounting for 40% of global forestation loss over this time period.

I'd also recommend that we study China as they had the greatest increase in forest area since 1990. Perhaps we could replicate some of their success in Brazil or other regions where forestation has decreased.

5. APPENDIX: SQL Queries Used

Create VIEW deforestation

```
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,
          r.region,
          r.income_group,
          Round(( f.forest_area_sqkm * 100 / ( l.total_area_sq_mi *
                2.59 ) ) :: numeric, 2) AS forest_pct_sqkm
   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);
```

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 *
FROM   forestation
WHERE  country_name = 'World'
       AND 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 *
FROM   forestation
WHERE  country_name = 'World'
       AND year = 2016
```

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

1,324,449 sq km

```
SELECT a.country_name,
       a.forest_area_sqkm AS forest1,
       b.forest_area_sqkm AS forest2,
       a.forest_area_sqkm - b.forest_area_sqkm AS change
FROM   forestation AS a
       JOIN forestation AS b
         ON a.country_name = b.country_name
WHERE  a.country_name = 'World'
       AND a.year = 1990
       AND b.year = 2016
```

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

3.21%

```
SELECT a.country_name,
       A.forest_area_sqkm AS forest90,
       B.forest_area_sqkm AS forest16,
       ( ( b.forest_area_sqkm -
       a.forest_area_sqkm ) / a.forest_area_sqkm ) * 100
                          AS pct_change
FROM   forestation AS a
       JOIN forestation AS b
         ON a.country_name = b.country_name
WHERE  a.country_name = 'World'
       AND a.year = 1990
       AND b.year = 2016
```

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 *,
       ( total_area_sq_mi * 2.59 ) AS total_area_sqkm
FROM   forestation
WHERE  ( total_area_sq_mi * 2.59 ) BETWEEN 1270000 AND 1300000
       AND year = 2016
```

```
ORDER  BY total_area_sq_mi
```

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?

Query 1:

```
SELECT *
FROM   forestation
WHERE  country_name = 'World'
       AND year = 2016
```

Query 2:

```
WITH land_area_sqkm AS
(
       SELECT f.country_code,
              f.year,
              ( total_area_sq_mi * 2.59 ) AS total_area_sqkm
       FROM   forestation AS f )

SELECT   f.region,
         Round((Sum(forest_area_sqkm) * 100 / Sum(total_area_sqkm))::
           numeric, 2) AS reg_pct_2016
FROM     forestation AS f
JOIN     land_area_sqkm AS l
ON       f.country_code=l.country_code
AND      f.year=l.year
WHERE    f.year = 2016
GROUP BY 1
ORDER BY 2 DESC limit 100
```

Query 3: same as 2, remove DESC from ORDER BY statement

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?

```
WITH land_area_sqkm AS
(
       SELECT f.country_code,
              f.year,
              ( total_area_sq_mi * 2.59 ) AS total_area_sqkm
       FROM   forestation AS f ),
regional_pct_2016 AS
(
         SELECT   f.region,
                  Round((Sum(forest_area_sqkm) * 100 /
                      Sum(total_area_sqkm)):: numeric, 2)
                      AS reg_pct_2016
         FROM     forestation AS f
         JOIN     land_area_sqkm AS l
         ON       f.country_code=l.country_code
         AND      f.year=l.year
         WHERE    f.year = 2016
         GROUP BY 1
         ORDER BY 2 )
--
SELECT   f.region,
         Round((Sum(forest_area_sqkm) * 100 / Sum(total_area_sqkm))::
           numeric, 2)  AS reg_pct_1990
FROM     forestation AS f
JOIN     land_area_sqkm AS l
ON       f.country_code=l.country_code
AND      f.year=l.year
WHERE    f.year = 1990
GROUP BY 1
ORDER BY 2 limit 100
```

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

```
WITH land_area_sqkm AS
(
       SELECT f.country_code,
              f.year,
              ( total_area_sq_mi * 2.59 ) AS total_area_sqkm
```

```
       FROM   forestation f),
regional_pct_2016 AS
(
         SELECT   f.region,
                  Round(( Sum(forest_area_sqkm) * 100 /
                     Sum(total_area_sqkm) ) :: numeric, 2)
                     AS reg_pct_2016
         FROM     forestation AS f
         JOIN     land_area_sqkm AS l
         ON       f.country_code = l.country_code
         AND      f.year = l.year
         WHERE    f.year = 2016
         GROUP BY 1
         ORDER BY 2),
regional_pct_1990 AS
(
         SELECT   f.region,
                  Round(( Sum(f.forest_area_sqkm) * 100 /
                     Sum(l.total_area_sqkm) ) :: numeric, 2)
                     AS reg_pct_1990
         FROM     forestation AS f
         JOIN     land_area_sqkm AS l
         ON       f.country_code = l.country_code
         AND      f.year = l.year
         WHERE    f.year = 1990
         GROUP BY 1
         ORDER BY 2)
--
SELECT DISTINCT f.region,
                reg1.reg_pct_1990,
                reg2.reg_pct_2016
FROM   forestation AS f
       JOIN regional_pct_2016 AS reg2
         ON f.region = reg2.region
       JOIN regional_pct_1990 AS reg1
         ON f.region = reg1.region
WHERE  reg1.reg_pct_1990 > reg2.reg_pct_2016
```

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?

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?

Query for A and B:
(ORDER BY col 3 or 4 / ascending or DESC depending on the question)

```
WITH forest_1990 AS
(
       SELECT f.country_name,
              f.forest_area_sqkm AS forest_area_1990
       FROM   forestation AS f
       WHERE  f.year = 1990
       AND    f.forest_area_sqkm IS NOT NULL ),
forest_2016 AS
(
       SELECT f.country_name,
              f.forest_area_sqkm AS forest_area_2016
       FROM   forestation AS f
       WHERE  f.year = 2016
       AND    f.forest_area_sqkm IS NOT NULL )
--
SELECT DISTINCT f.country_name,
                f.region,
                f90.forest_area_1990 - f16.forest_area_2016
                     AS dif_area,
                Round (((f16.forest_area_2016 - f90.forest_area_1990
)
                     / f90.forest_area_1990)::numeric,2) AS dif_pct
FROM            forestation AS f
JOIN            forest_1990 AS f90
ON              f.country_name=f90.country_name
JOIN            forest_2016 AS f16
ON              f.country_name=f16.country_name
ORDER BY        4 DESC limit 100
```

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

```
SELECT q.quartiles,
       Count(*)
FROM   (SELECT f.country_name,
               f.year,
               f.forest_pct_sqkm,
               CASE
                 WHEN f.forest_pct_sqkm >= 75 THEN '75-100'
                 WHEN f.forest_pct_sqkm >= 50 THEN '50-75'
                 WHEN f.forest_pct_sqkm >= 25 THEN '25-50'
                 ELSE '0-25'
               END AS quartiles
        FROM   forestation AS f
        WHERE  year = 2016
               AND f.forest_pct_sqkm IS NOT NULL
               AND f.country_name <> 'World') q
GROUP  BY 1
ORDER  BY 1
```

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

Suriname, Micronesia, Gabon, Seychelles, Palau, American Samoa, Guyana, Lao PDR, Solomon Islands

```
SELECT q.country_name,
       r.region,
       q.forest_pct_sqkm
FROM   (SELECT f.country_name,
               f.year,
               f.forest_pct_sqkm,
               CASE
                 WHEN f.forest_pct_sqkm >= 75 THEN '75-100'
                 WHEN f.forest_pct_sqkm >= 50 THEN '50-75'
                 WHEN f.forest_pct_sqkm >= 25 THEN '25-50'
                 ELSE '0-25'
               end AS quartiles
        FROM   forestation AS f
        WHERE  year = 2016
               AND f.forest_pct_sqkm IS NOT NULL
               AND f.country_name <> 'World') q
       JOIN regions AS r
```

```
          ON q.country_name = r.country_name
WHERE  q.quartiles = '75-100'
ORDER  BY 3 DESC
```

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

94 countries

```
WITH q
     AS (SELECT f.country_name,
                f.year,
                f.forest_pct_sqkm,
                CASE
                  WHEN f.forest_pct_sqkm >= 75 THEN '75-100'
                  WHEN f.forest_pct_sqkm >= 50 THEN '50-75'
                  WHEN f.forest_pct_sqkm >= 25 THEN '25-50'
                  ELSE '0-25'
                END AS quartiles
         FROM   forestation AS f
         WHERE  year = 2016
                AND f.forest_pct_sqkm IS NOT NULL
                AND f.country_name <> 'World')

SELECT Count(*)
FROM   q
WHERE  q.forest_pct_sqkm > (SELECT q.forest_pct_sqkm
                            FROM   q
                            WHERE  q.country_name = 'United States')
```