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 s 41282694.9 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sqkm, a loss of 1324449 sqkm, 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 1279999.9 sqkm).

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	Forest area 1990%	Forest area 2016%	diff
Latin America & Caribbean	51.03	46.16	-4.87
Europe & Central Asia	37.28	38.04	0.76
North America	35.65	36.04	0.39
World	32.42	31.38	-1.04
Sub-Saharan Africa	30.67	28.79	-1.88
East Asia & Pacific	25.78	26.36	0.58
South Asia	16.51	17.51	1.00
Middle East & North Africa	1.78	2.07	0.29

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 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 79200, 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% 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 name	**Region**	**Forest area 1990**	**Forest area 2016**	**diff**
World	World	41282695	39958246	1324449
Brazil	Latin America & Caribbean	5467050	4925540	541510
Indonesia	East Asia & Pacific	1185450	903256	282194
Myanmar	East Asia & Pacific	392180	284946	107234
Nigeria	Sub-Saharan Africa	172340	65834	106506

Tanzania	Sub-Saharan Africa	559200	456880	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 name	**Region**	**Forest area 1990**	**Forest area 2016**	**Percentage Change**
Togo	Sub-Saharan Africa	6850	1682	-75.45
Nigeria	Sub-Saharan Africa	172340	65834	-61.80
Uganda	Sub-Saharan Africa	47510	19418	-59.13
Mauritania	Sub-Saharan Africa	4150	2210	-46.75
Honduras	Latin America &	81360	44720	-45.03

	Caribbean			

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 the forest as well as the 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:

Forestation Quartile	Number of Countries
0-25%	85
25% -50%	73
50% - 75%	38
75% -100%	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:

9 results

country_name	region	forest_percentage
American Samoa	East Asia & Pacific	87.50
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Palau	East Asia & Pacific	87.61
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26
Seychelles	Sub-Saharan Africa	88.41

5. RECOMMENDATIONS

The world lost 3.2% of its forest area from 1990 to 2016, an area larger than Peru.
In Latin America & the Caribbean and sub-Saharan Africa, forest area is declining the most.
Due to the large percentage of forest in these areas, this decline affects the whole world, even in other regions, forest area is increasing.
In contrast, countries like China and the United States have shown a great increase in their forest areas, and smaller countries - like Iceland - have made great efforts and achieved results.
Brazil shows a big decline in forest area, there are countries with a big decrease in forest percentage, and there are countries like Nigeria that demonstrate a huge decrease in both.
There are 89 countries in the first quarantine of forest area (less than 25%).
There are only nine countries in the last quartile.
Focus should be placed on the countries with the greatest decline in forest area (listed above) in Latin America & the Caribbean and sub-Saharan Africa.

APPENDIX

VIEW:

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
  (SELECT forest_area.country_code,
          forest_area.year,
          forest_area.forest_area_sqkm,
          land_area.country_name,
          land_area.total_area_sq_mi,
          regions.region,
          regions.income_group,
          forest_area.forest_area_sqkm * 100 /
          ( land_area.total_area_sq_mi * 2.59 )
                                          forest_percentage,
          land_area.total_area_sq_mi * 2.59 total_area_sqkm
   FROM   forest_area
          JOIN land_area USING(country_code, YEAR)
          JOIN regions USING(country_code));

----------------------
SELECT *
FROM   forestation;
```

Areas 1990,2016 and difference (in km, and percentages)

```
WITH areas_2016
     AS (SELECT forest_area_sqkm a_2016,
                year
         FROM   forestation
         WHERE  country_name = 'World'
                AND year = 2016),
     areas_1990
     AS (SELECT forest_area_sqkm a_1990,
                year
         FROM   forestation
         WHERE  country_name = 'World'
                AND year = 1990),
     diffs
     AS (SELECT a_2016,
                a_1990,
                a_2016 - a_1990                    diff,
```

```
                ( a_2016 - a_1990 ) / a_1990 * 100 diff_percentegaes
         FROM   areas_1990,
                areas_2016)
SELECT a_2016,
       a_1990,
       diff,
       Round(diff_percentegaes :: NUMERIC, 2) diff_percentages
FROM   diffs
```

Closest country to this area:
There are two main ways how to solve this problem -

- **this is the more sophisticated way - by reducing the area from the area of every country, calculating the absolute value, and ordering the results from the small number up:**

```
SELECT DISTINCT country_name,total_area_sqkm,
                Abs(total_area_sqkm - 1324449)
FROM   forestation
ORDER  BY Abs(total_area_sqkm - 1324449)
LIMIT  1
```

- **The basic way is simply to try numbers and use between, like:**

```
SELECT DISTINCT country_name,
                total_area_sqkm
FROM   forestation
WHERE  total_area_sqkm BETWEEN 1270000 AND 1350000
```

Regions percentages differences

```
WITH forest_percentage_1990
     AS (SELECT region,
                ( SUM(forest_area_sqkm) * 100 / SUM(total_area_sqkm) )
                   percentage_forest_1990
         FROM   forestation
         WHERE  year = 1990
         GROUP  BY region),
     forest_percentage_2016
     AS (SELECT region,
                ( SUM(forest_area_sqkm) * 100 / SUM(total_area_sqkm) )
                   percentage_forest_2016
         FROM   forestation
```

```
        WHERE  year = 2016
        GROUP  BY region),
     joinded_tables
     AS (SELECT *,
                percentage_forest_2016 - percentage_forest_1990 diff
         FROM   forest_percentage_1990
                join forest_percentage_2016 USING(region))
SELECT *,
       Round(diff :: NUMERIC, 2) AS diff
FROM   joinded_tables
```

Countries success stories (areas increase change)

```
WITH countries_2016 AS
(
       SELECT forest_area_sqkm AS c_2016,
              country_name,
              region
       FROM   forestation
       WHERE  year = 2016
       AND    forest_area_sqkm IS NOT NULL), countries_1990 AS
(
       SELECT forest_area_sqkm AS c_1990,
              country_name,
              region
       FROM   forestation
       WHERE  year = 1990
       AND    forest_area_sqkm IS NOT NULL)
SELECT   country_name,
         (c_2016 - c_1990) AS forest_change,
         countries_1990.region,
         Round(((c_2016 - c_1990)*100/c_1990)::numeric,2) AS fp_change
FROM     countries_1990
JOIN     countries_2016
using   (country_name)
ORDER BY forest_change DESC limit 6
```

Countries “not success” (decrease) stories - areas change

```
WITH countries_2016 AS
(
```

```
        SELECT forest_area_sqkm AS c_2016,
               country_name,
               region
        FROM   forestation
        WHERE  year = 2016
        AND    forest_area_sqkm IS NOT NULL), countries_1990 AS
(
        SELECT forest_area_sqkm AS c_1990,
               country_name,
               region
        FROM   forestation
        WHERE  year = 1990
        AND    forest_area_sqkm IS NOT NULL)
SELECT   country_name,
         (c_2016 - c_1990) AS forest_change,
         countries_1990.region,
         Round(((c_2016 - c_1990)*100/c_1990)::numeric,2) AS fp_change
FROM     countries_1990
JOIN     countries_2016
using   (country_name)
ORDER BY forest_change limit 6
```

Countries forest percentages changes - decrease

```
WITH countries_2016 AS
(
        SELECT forest_area_sqkm AS c_2016,
               country_name,
               region
        FROM   forestation
        WHERE  year = 2016
        AND    forest_area_sqkm IS NOT NULL), countries_1990 AS
(
        SELECT forest_area_sqkm AS c_1990,
               country_name,
               region
        FROM   forestation
        WHERE  year = 1990
        AND    forest_area_sqkm IS NOT NULL)
SELECT   country_name,
         (c_2016 - c_1990)/c_1990*100 AS forest_change_percentages,
         countries_1990.region,
```

```
        Round(((c_2016 - c_1990)*100/c_1990)::numeric,2) AS fp_change
FROM    countries_1990
JOIN    countries_2016
using  (country_name)
ORDER BY forest_change_percentages limit 6
```

Countries forest percentages change - increase

```
WITH countries_2016 AS
(
       SELECT forest_area_sqkm AS c_2016,
              country_name,
              region
       FROM   forestation
       WHERE  year = 2016
       AND    forest_area_sqkm IS NOT NULL), countries_1990 AS
(
       SELECT forest_area_sqkm AS c_1990,
              country_name,
              region
       FROM   forestation
       WHERE  year = 1990
       AND    forest_area_sqkm IS NOT NULL)
SELECT   country_name,
         (c_2016 - c_1990)/c_1990*100 AS forest_change_percentages,
         countries_1990.region,
         Round(((c_2016 - c_1990)*100/c_1990)::numeric,2) AS fp_change
FROM    countries_1990
JOIN    countries_2016
using  (country_name)
ORDER BY forest_change_percentages DESC limit 6
```

Quartiles

- **Here too there are two ways to solve this exercise - the sophisticated way is this:**

```
WITH quartiles_table
     AS (SELECT f.country_name,
                Ceil(f.forest_percentage / 25) quartiles
         FROM   forestation f
         WHERE  year = 2016
```

```
                AND f.forest_percentage IS NOT NULL
                AND country_name != 'World')
SELECT quartiles,
       Count(*)
FROM   quartiles_table
GROUP  BY quartiles
ORDER  BY quartiles
```

- **But the most common way is this:**

```
WITH t1
     AS (SELECT f.country_name,
                f.forest_percentage,
                CASE
                  WHEN f.forest_percentage >= 75 THEN '75%-100%'
                  WHEN f.forest_percentage >= 50 THEN '50%-75%'
                  WHEN f.forest_percentage >= 25 THEN '25%-50%'
                  ELSE '0-25%'
                END AS quartiles
         FROM   forestation f
         WHERE  year = 2016
                AND f.forest_percentage IS NOT NULL
                AND country_name != 'World')
SELECT quartiles,
       Count(*)
FROM   t1
GROUP  BY quartiles
ORDER  BY quartiles
```

Countries in top quartile

```
SELECT country_name,
       region,
       Round(forest_percentage :: NUMERIC, 2)
FROM   forestation
WHERE  forest_percentage > 75
       AND year = 2016
```

Number of Countries with forest area more than usa

```
WITH usa
     AS (SELECT forest_percentage usa_percentage
```

```
        FROM   forestation
        WHERE  country_code = 'USA'
               AND year = 2016),
     countries
     AS (SELECT country_name
        FROM   forestation,
               usa
        WHERE  forest_percentage > usa_percentage
               AND year = 2016)
SELECT Count(*)
FROM   countries
```