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 41,282,694.90 square kilometers in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.90, a loss of 1,324,449 square kilometers, or 3.21 %.

The forest area lost over this time period is slightly more than the entire land area of Perú listed for the year 2016 (which is 1,279,999.99 square kilometers).

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
Latin America & Caribbean	51,03%	46,16%
Sub-Saharan Africa	32,19%	27,56%
Middle East & North Africa	1,78%	2,07%

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 (32,19% to 27,56%). 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 square kilometers. 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 square kilometers, 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
Brazil	Latin America & Caribbean	541,510
Indonesia	East Asia & Pacific	282,193.98
Myanmar	East Asia & Pacific	107,234
Nigeria	Sub-Saharan Africa	106,506
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	75,45%
Nigeria	Sub-Saharan Africa	61,80%
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 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	98.26%
Micronesia, Fed. Sts.	East Asia & Pacific	91.86%
Gabon	Sub-Saharan Africa	90.04%
Seychelles	Sub-Saharan Africa	88.41%
Palau	East Asia & Pacific	87.61%
American Samoa	East Asia & Pacific	87.5%
Guyana	Latin America & Caribbean	83.9%
Lao PDR	East Asia & Pacific	82.11%

Solomon Islands	East Asia & Pacific	77.86%

4. RECOMMENDATIONS

From the exploration of the Deforestation database, we determine that the areas with the biggest forest areas in the world are located in the East Asia & Pacific, Latin America & Caribbean and Sub-Saharan Africa regions.

However, the countries that have suffered the most from deforestation also belong to the aforementioned regions, being Brazil the most deforested in absolute terms, and Togo percentage wise (more than 75% of the designated forest areas of this country have been lost).

Nigeria deserves a special mention because it's in the top 5 decrease in forest area, both in absolute and relative (percentage wise) terms.

Therefore, countries like Brazil, Togo and Nigeria could take inspiration in the success of both powerful and big nations, such as China and the United States, and small countries like Iceland, which have successfully managed to increase their forest areas from 1990 to 2016.

This would be a great starting point to remedy the world-wide loss of forests, which up until 2016, amounts to an area roughly the size of Perú!

5. APPENDIX - QUERIES

```
CREATE OR REPLACE VIEW forestation AS
(
WITH all_area AS (SELECT fa.*,
                         la.total_area_sq_mi * 2.59 AS total_area_sqkm
                  FROM land_area la
                         JOIN
                         forest_area fa ON fa.country_code = la.country_code
                         AND fa.year = la.year
                         AND fa.forest_area_sqkm IS NOT NULL
                         AND la.total_area_sq_mi IS NOT NULL)
SELECT aa.*,
       r.region,
       r.income_group,
       100 * (aa.forest_area_sqkm / aa.total_area_sqkm) AS forest_percent
```

```
FROM all_area aa
        JOIN
        regions r ON aa.country_code = r.country_code);

-------------------------------------------------------
---------------------- PART 1 ----------------------
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-- (1.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 forest_area_sqkm AS total_forest_area
FROM forestation
WHERE country_code = 'WLD'
  AND year = 1990;

-- (1.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 forest_area_sqkm AS total_forest_area
FROM forestation
WHERE country_code = 'WLD'
  AND year = 2016;

-- (1.c)
--  What was the change (in sq km) in the forest area of the world from 1990 to 2016?
SELECT f1990.country_name,
        ROUND((f2016.forest_area_sqkm - f1990.forest_area_sqkm)::NUMERIC, 2) AS change
FROM forestation f1990
        JOIN forestation f2016 ON f1990.country_code = f2016.country_code
        AND f1990.country_code = 'WLD'
        AND f1990.year = 1990
        AND f2016.year = 2016;

-- (1.d)
-- What was the percent change in forest area of the world between 1990 and 2016?
SELECT f1990.country_name,
        ROUND(((f2016.forest_area_sqkm - f1990.forest_area_sqkm) / f1990.forest_area_sqkm * 100)::NUMERIC,
2) AS change
FROM forestation f1990
        JOIN forestation f2016 ON f1990.country_code = f2016.country_code
        AND f1990.country_code = 'WLD'
        AND f1990.year = 1990
        AND f2016.year = 2016;

-- (1.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 country_name,
        total_area_sqkm,
        ABS(total_area_sqkm
        -
        -- The subtraction below gives us the number of square kilometers of forest area
        -- that we've lost.
        (SELECT ROUND((f1990.forest_area_sqkm - f2016.forest_area_sqkm)::NUMERIC, 2) AS change
        FROM forestation f1990
                JOIN forestation f2016 ON f1990.country_code = f2016.country_code
        AND f1990.country_code = 'WLD'
        AND f1990.year = 1990
        AND f2016.year = 2016)
        ) AS delta
FROM forestation
WHERE year = 2016
AND country_name != 'World'
ORDER BY delta
LIMIT 1;

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---------------------- PART 2 ----------------------
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CREATE OR REPLACE VIEW forestation_per_region AS
(
SELECT region,
        100 * SUM(forest_area_sqkm) / SUM(total_area_sqkm) as forest_percent,
        year
FROM forestation
WHERE year IN (1990, 2016)
GROUP BY region, year);

--------------------

-- (2.a)
-- What was the percent forest of the entire world in 2016?
SELECT region, ROUND(forest_percent::NUMERIC, 2)
FROM forestation_per_region
WHERE year = 2016
  AND region = 'World';

-- Which region had the HIGHEST percent forest in 2016,
-- and which had the LOWEST, to 2 decimal places?
SELECT region, ROUND(forest_percent::NUMERIC, 2) as forest_percent
FROM forestation_per_region
WHERE year = 2016
ORDER BY forest_percent DESC;

-- b. What was the percent forest of the entire world in 1990?
SELECT region, ROUND(forest_percent::NUMERIC, 2)
```

```
FROM forestation_per_region
WHERE year = 1990
  AND region = 'World';

-- Which region had the HIGHEST percent forest in 1990,
-- and which had the LOWEST, to 2 decimal places?
SELECT region, ROUND(forest_percent::NUMERIC, 2) as forest_percent
FROM forestation_per_region
WHERE year = 1990
ORDER BY forest_percent DESC;

-- c. Based on the table you created,
-- which regions of the world DECREASED in forest area from 1990 to 2016?
SELECT fr1990.region,
        ROUND(fr1990.forest_percent::NUMERIC, 2)          AS forest_percent_1990,
        ROUND(fr2016.forest_percent::NUMERIC, 2)          AS forest_percent_2016,
        ROUND((fr1990.forest_percent - fr2016.forest_percent)::NUMERIC, 2) AS decrease
FROM forestation_per_region AS fr1990,
        forestation_per_region AS fr2016
WHERE fr2016.year = 2016
  AND fr1990.year = 1990
  AND fr1990.region = fr2016.region
ORDER BY decrease DESC;


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---------------------- PART 3 ----------------------
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-- 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?
SELECT fr1990.region,
        fr1990.country_name,
        ROUND(fr1990.forest_area_sqkm::NUMERIC, 2)          AS forest_area_1990,
        ROUND(fr2016.forest_area_sqkm::NUMERIC, 2)          AS forest_area_2016,
        ROUND((fr1990.forest_area_sqkm - fr2016.forest_area_sqkm)::NUMERIC, 2) AS decrease
FROM forestation AS fr1990,
        forestation AS fr2016
WHERE fr2016.year = 2016
  AND fr1990.year = 1990
  AND fr1990.country_name = fr2016.country_name
  AND fr1990.country_name != 'World'
ORDER BY decrease 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?
SELECT fr1990.region,
        fr1990.country_name,
        ROUND(fr1990.forest_area_sqkm::NUMERIC, 2)       AS forest_area_1990,
        ROUND(fr2016.forest_area_sqkm::NUMERIC, 2)       AS forest_area_2016,
```

```
        ROUND(((fr1990.forest_area_sqkm - fr2016.forest_area_sqkm) /
        fr1990.forest_area_sqkm * 100)::NUMERIC, 2) AS decrease
FROM forestation AS fr1990,
        forestation AS fr2016
WHERE fr2016.year = 2016
  AND fr1990.year = 1990
  AND fr1990.country_name = fr2016.country_name
  AND fr1990.country_name != 'World'
ORDER BY decrease DESC;
```

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

```
SELECT DISTINCT quartile,
        COUNT(country_name) OVER (PARTITION BY quartile) AS count
FROM (SELECT (CASE
        WHEN forest_percent <= 25 THEN '0%-25%'
        WHEN 25 < forest_percent AND forest_percent <= 50 THEN '25%-50%'
        WHEN 50 < forest_percent AND forest_percent <= 75 THEN '50%-75%'
        WHEN forest_percent > 75 THEN '75%-100%' END) AS quartile,
        country_name
        FROM forestation
        WHERE forest_percent IS NOT NULL
        AND year = 2016
        AND country_name != 'World') AS quantiles
ORDER BY count DESC;
```

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

```
SELECT region,
        country_name,
        ROUND(forest_percent::NUMERIC, 2) as forest_percent
FROM forestation
WHERE forest_percent IS NOT NULL
  AND forest_percent > 75
  AND year = 2016
  AND country_name != 'World'
ORDER BY forest_percent DESC;
```

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

```
SELECT COUNT(country_code)
FROM forestation
WHERE forest_percent > (SELECT forest_percent
                        FROM forestation
                        WHERE country_code = 'USA'
                        AND year = 2016)
  AND year = 2016
  AND country_name != 'World';
```