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 square kilometers in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 square kilometers, a loss of 1324449, 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 1279999.9891).

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 and Caribbean, with 46.16%, and the region with the lowest relative forestation was Middle East and 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 and Caribbean, with 51.03%, and the region with the lowest relative forestation was Middle East and North Africa with 1.76% 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%
Europe & Central Asia	37.28%	38.04%

North America	35.65%	36.04%
Sub-Saharan Africa	30.67%	28.36%
East Asia & Pacific	25.78%	26.36%
South Asia	16.51%	17.51%
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 Africa (dropped from 51.03% to 46.16%) and Sub-Saharan Africa (30.67% to 28.36%). 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 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 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 213.66% 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 5 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	-1324449

Indonesia	East Asia	-282193.98
Myanmar	East Asia	-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	-61.80%
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

Between 1990 and 2016, the world has lost 41282694.9 square kilometers of forest. This is a decrease of 3.2% of the world's total forest as is an area the size of Peru that has been lost. Despite this grim outlook, the regions of South Asia and Middle East & North Africa have actually increased their total forest area with China seeing an increase of 527229 square kilometers.
The largest country of concern is Brazil which has lost 1324449 square kilometers and every effort should now be made to reverse this decline. The other countries that have seen the largest decline in their forest areas are Indonesia, Myanmar, Nigeria and Tanzania. When considering those countries that have lost the largest percentage of their forest, Togo is an alarming example which has lost over 75% of its total forest. The countries with the four highest

rates of deforestation are all in the region of Sub-Saharan Africa. This is a region that focus should be applied to. With the success story of China, it is recommended to employ the strategies used by China in the countries with the highest deforestation figures in order to highlight the underlying cause of the deforestation and what is driving the demand for it. Additionally, collaboration on an international level is recommended with the most at risk countries and regions in an effort to reverse this staggering decline of the World's forests.

5. APPENDIX: SQL Queries Used

--To Create the 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 * 2.59 AS total_area_sqkm,
        forest_area.forest_area_sqkm / (land_area.total_area_sq_mi * 2.59) * 100 AS
forest_percentage,
        regions.region,
        regions.income_group
    FROM
        forest_area
    LEFT JOIN
        land_area ON forest_area.country_code = land_area.country_code AND
forest_area.year = land_area.year
    LEFT JOIN
        regions ON land_area.country_code = regions.country_code
);
```

TASK 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, year
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 forest_area_sqkm, year
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?

```
SELECT f1.forest_area_sqkm - f2.forest_area_sqkm as difference
FROM forestation f1
JOIN forestation f2
ON f1.country_name = f2.country_name
WHERE f1.country_name = 'World' and f1.year = 1990 and f2.year = 2016;
```

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

```
WITH area_2016 AS (
  SELECT forest_area_sqkm AS f_area_2016
  FROM forestation
  WHERE country_name = 'World' AND year = 2016
),
area_1990 AS (
  SELECT forest_area_sqkm AS f_area_1990
  FROM forestation
  WHERE country_name = 'World' AND year = 1990
),
diff AS (
  SELECT
    a90.f_area_1990,
    a16.f_area_2016,
    a90.f_area_1990 - a16.f_area_2016 AS diff,
    ((a16.f_area_2016 - a90.f_area_1990) / a90.f_area_1990) * 100 AS diff_percentage
  FROM area_1990 a90
  JOIN area_2016 a16 ON 1=1
)
SELECT
  f_area_2016,
  f_area_1990,
  diff,
  ROUND(diff_percentage::numeric, 2) AS diff_percentage
FROM diff;
```

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 distinct country_name, total_area_sqkm
FROM forestation
WHERE total_area_sqkm BETWEEN 1267000 and 1324449
AND year = 2016;
```

TASK 2

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?

```
SELECT country_name, total_area_sqkm, forest_area_sqkm,
ROUND(((forest_area_sqkm/total_area_sqkm)*100)::numeric,2) AS percent_forestation
FROM forestation
WHERE year = 2016 AND country_name = 'World';
```

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?

```
SELECT region,
ROUND((SUM(forest_area_sqkm)*100/SUM(total_area_sqkm))::numeric,2) AS
percent_forestation
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percent_forestation DESC;
```

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

```
SELECT region,
(SUM(forest_area_sqkm)*100/SUM(total_area_sqkm)) AS percent_forestation_2016
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percent_forestation_2016 DESC;
```

TASK 3

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 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
),
forest_change AS (
  SELECT
    c90.country_name,
    (c16.c_2016 - c90.c_1990) AS forest_change,
    ((c16.c_2016 - c90.c_1990) * 100 / c90.c_1990) AS fp_change,
    c90.region
  FROM countries_1990 c90
  LEFT JOIN countries_2016 c16 ON c90.country_name = c16.country_name
)
SELECT country_name, forest_change, fp_change, region
FROM forest_change
ORDER BY forest_change
LIMIT 6;
```

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 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
),
forest_change AS (
  SELECT
    c90.country_name,
    (c16.c_2016 - c90.c_1990) AS forest_change,
    ROUND(((c16.c_2016 - c90.c_1990) * 100 / c90.c_1990)::numeric, 2) AS
forest_percent_change,
    c90.region
  FROM countries_1990 c90
  LEFT JOIN countries_2016 c16 ON c90.country_name = c16.country_name
)
SELECT country_name, forest_change, forest_percent_change, region
FROM forest_change
ORDER BY forest_change
LIMIT 6;
```

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

```
WITH t1 AS (
  SELECT
    f.country_name,
    f.forest_percentage,
    f.region,
    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
  country_name,
  region,
  quartiles,
  MAX(forest_percentage) AS forest_percentage
```

```
FROM
  t1
GROUP BY
  country_name,
  region,
  quartiles
ORDER BY
  forest_percentage DESC;
```