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 km^2** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 km^2** ,a loss of **1324449 km^2**, 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 km^2**).

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
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
South Asia	16.51	17.51
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 **527229.06 km^2**. 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 km^2**, 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	541510.00
Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234.00
Nigeria	Sub-Saharan Africa	106506.00
Tanzania	Sub-Saharan Africa	102320.00

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	75.44%
Nigeria	Sub-Saharan Africa	61.79%
Uganda	Sub-Saharan Africa	59.12%
Mauritania	Sub-Saharan Africa	46.74%
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%	73
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	98.25%

Micronesia, Fed. Sts.	East Asia & Pacific	91.85%
Gabon	Sub-Saharan Africa	90.03%
Seychelles	Sub-Saharan Africa	88.41%
Palau	East Asia & Pacific	87.60%
American Samoa	East Asia & Pacific	87.50%
Guyana	Latin America & Caribbean	83.90%
Lao PDR	East Asia & Pacific	82.10%
Solomon Islands	East Asia & Pacific	77.86%

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?*

The World Bank data highlights a troubling global decline in forest area, with a reduction from 41,282,694.9 km² in 1990 to 39,958,245.9 km² in 2016, amounting to a 3.2% loss. Regionally, Latin America & Caribbean had the highest forestation percentage in 2016 at 46.16%, while the Middle East & North Africa had the lowest at 2.07%. Between 1990 and 2016, only Latin America & Caribbean and Sub-Saharan Africa saw decreases in forest area percentage. On a country level, China emerged as a success story by increasing its forest area by 527,229.06 km². Conversely, Brazil, Indonesia, and Myanmar experienced the most significant absolute decreases in forest area, while Togo, Nigeria, and Uganda had the highest percentage decreases. Nigeria, in particular, is notable for ranking high in both absolute and percentage losses, signaling a critical need for intervention.

Recommendations for the ForestQuery team include focusing efforts on Latin America & Caribbean and Sub-Saharan Africa, with priority given to countries like Brazil, Indonesia, Nigeria, Togo, and Uganda. Encouraging policy and knowledge exchanges from successful reforestation countries like China to those facing severe deforestation will be beneficial. Engaging local communities in conservation through education and sustainable initiatives, raising awareness about forest conservation, and investing in monitoring systems to track progress are crucial steps. Conducting research to understand deforestation drivers and developing innovative solutions will help in effectively combating global deforestation.

5. APPENDIX: SQL Queries Used

```
CREATE VIEW forestation AS
SELECT
  fa.country_code,
  fa.country_name,
  fa.year,
  SUM(fa.forest_area_sqkm) AS total_forest_area_sqkm,
  la.total_area_sq_mi,
  la.total_area_sq_mi * 2.59 AS total_area_sqkm,
  re.region,
  re.income_group,
  AVG(fa.forest_area_sqkm / (la.total_area_sq_mi * 2.59)) * 100 AS
avg_forest_percent
FROM forest_area AS fa
JOIN land_area AS la ON fa.country_code = la.country_code AND fa.year = la.year
JOIN regions re ON re.country_code = la.country_code
GROUP BY fa.country_code, fa.country_name, fa.year, re.region, re.income_group,
la.total_area_sq_mi;
```

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 total_forest_area_sqkm
FROM forestation
WHERE YEAR = 1990
AND country_name = 'World';
```

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 total_forest_area_sqkm
FROM forestation
WHERE YEAR = 2016
AND country_name = 'World';
```

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

```
WITH forest_1990 AS (
  SELECT SUM(total_forest_area_sqkm) AS total_1990
  FROM forestation
  WHERE year = 1990 AND country_name = 'World'
),
forest_2016 AS (
  SELECT SUM(total_forest_area_sqkm) AS total_2016
  FROM forestation
```

```
  WHERE year = 2016 AND country_name = 'World'
)
SELECT
  (f1.total_1990 - f2.total_2016) AS Forest_Area
FROM forest_1990 f1, forest_2016 f2;
```

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

```
SELECT (
  SUM(total_forest_area_sqkm) FILTER (WHERE year = 1990) -
  SUM(total_forest_area_sqkm) FILTER (WHERE year = 2016)
) /
  SUM(total_forest_area_sqkm) FILTER (WHERE year = 1990) * 100 AS
Percent_Forest_Area
FROM forestation
WHERE country_name = 'World';
```

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,
       SUM(CAST(total_area_sq_mi AS DECIMAL(10,2)) * 2.59) AS total_area_of_land
FROM forestation
WHERE YEAR = 2016
AND CAST(total_area_sq_mi AS DECIMAL(10,2)) * 2.59 <= 1324449
GROUP BY country_name
ORDER BY total_area_of_land DESC
LIMIT 1;
```

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?

```
SELECT Round(((SUM(total_forest_area_sqkm) / SUM(total_area_sq_mi*2.59)) *
100)::Numeric, 2) AS Percent_Forest
FROM forestation
WHERE YEAR = 2016
AND country_name = 'World';
```

HIGHEST & LOWEST

```
(SELECT region, Round(((SUM(total_forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest
FROM forestation
WHERE YEAR = 2016
GROUP BY region
ORDER BY Percent_Forest DESC
LIMIT 1)
UNION ALL
```

```
(SELECT region, Round(((SUM(total_forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest
FROM forestation
WHERE YEAR = 2016
GROUP BY region
ORDER BY Percent_Forest ASC
LIMIT 1);
```

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 Round(((SUM(total_forest_area_sqkm) / SUM(total_area_sq_mi*2.59)) *
100)::Numeric, 2) AS Percent_Forest
FROM forestation
WHERE YEAR = 1990
AND country_name = 'World';
```

HIGHEST & LOWEST

```
(SELECT region, Round(((SUM(total_forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest
FROM forestation
WHERE YEAR = 1990
GROUP BY region
ORDER BY Percent_Forest DESC
LIMIT 1)
UNION ALL
(SELECT region, Round(((SUM(total_forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest
FROM forestation
WHERE YEAR = 1990
GROUP BY region
ORDER BY Percent_Forest ASC
LIMIT 1);
```

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

```
SELECT region,
  CASE WHEN YEAR = 1990 THEN
    Round(((SUM(total_forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)) *
100)::Numeric, 2)
  ELSE NULL
  END AS Percent_Forest_1990,
  CASE WHEN YEAR = 2016 THEN
    Round(((SUM(total_forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)) *
100)::Numeric, 2)
  ELSE NULL
```

```
  END AS Percent_Forest_2016
FROM forestation
WHERE YEAR IN (1990, 2016)
GROUP BY region, YEAR
ORDER BY YEAR, region;
```

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?

```
WITH ForestArea AS (
  SELECT
    country_code,
    country_name,
    region,
    SUM(CASE WHEN year = 1990 THEN total_forest_area_sqkm ELSE 0 END) AS
Forest_Area_1990,
    SUM(CASE WHEN year = 2016 THEN total_forest_area_sqkm ELSE 0 END) AS
Forest_Area_2016
  FROM forestation
  WHERE year IN (1990, 2016)
  GROUP BY country_code, country_name, region
)
SELECT
  country_name,
  region,
  ROUND(
    (Forest_Area_2016 - Forest_Area_1990)::NUMERIC,
    2
  ) AS Difference_Area
FROM ForestArea
WHERE country_name NOT LIKE 'World'
ORDER BY Difference_Area
LIMIT 5;
```

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 T1 AS (
    SELECT
        country_name,
        region,
        ROUND(total_forest_area_sqkm::NUMERIC, 2) AS Percent_Forest_1990
    FROM forestation
    WHERE year = 1990
    GROUP BY country_name, region, total_forest_area_sqkm
),
```

```
T2 AS (
    SELECT
        country_name,
        region,
        ROUND(total_forest_area_sqkm::NUMERIC, 2) AS Percent_Forest_2016
    FROM forestation
    WHERE year = 2016
    GROUP BY country_name, region, total_forest_area_sqkm
)
SELECT
    fa.country_name,
    fa.region,
    fa.Percent_Forest_1990,
    ta.Percent_Forest_2016,
    fa.Percent_Forest_1990 - ta.Percent_Forest_2016 AS Difference_Land_Area,
    ((fa.Percent_Forest_1990 - ta.Percent_Forest_2016) / fa.Percent_Forest_1990 *
100) AS Difference_Percentage_Land_Area
FROM T1 AS fa
JOIN T2 AS ta
    ON fa.country_name = ta.country_name
WHERE
    fa.Percent_Forest_1990 IS NOT NULL
    AND ta.Percent_Forest_2016 IS NOT NULL
    AND fa.country_name != 'World'
ORDER BY Difference_Percentage_Land_Area DESC
LIMIT 5;
```

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

```
WITH T1 AS (
    SELECT
        country_name,
        year,
        (SUM(total_forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)) * 100 AS
Percent_Forest_in_Quartiles
    FROM forestation
    WHERE year = 2016
    GROUP BY country_name, year
)
, Quartiles AS (
    SELECT
        country_name,
        CASE
            WHEN Percent_Forest_in_Quartiles < 25 THEN '0-25%'
```

```
            WHEN Percent_Forest_in_Quartiles >= 25 AND
Percent_Forest_in_Quartiles < 50 THEN '25-50%'
            WHEN Percent_Forest_in_Quartiles >= 50 AND
Percent_Forest_in_Quartiles < 75 THEN '50-75%'
            ELSE '75-100%'
        END AS quartiles
    FROM T1
    WHERE Percent_Forest_in_Quartiles IS NOT NULL
)
SELECT
    DISTINCT quartiles,
    COUNT(country_name) OVER (PARTITION BY quartiles) AS country_count
FROM Quartiles
ORDER BY quartiles;
```

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

```
SELECT country_name, region,avg_forest_percent AS Percent_Quartile
FROM forestation
WHERE avg_forest_percent > 75 AND year = 2016
GROUP BY country_name, region, avg_forest_percent
ORDER BY Percent_Quartile DESC;

SELECT
    country_name,
    region,
    avg_forest_percent AS Percent_Quartile
FROM forestation
WHERE
    avg_forest_percent > 75
    AND year = 2016
GROUP BY
    country_name,
    region,
    avg_forest_percent
ORDER BY
    Percent_Quartile DESC;
```

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

```
WITH US_Forest_Percent AS (
    SELECT avg_forest_percent
    FROM forestation
    WHERE country_name = 'United States' AND year = 2016
)
SELECT COUNT(*)
FROM forestation
```

```
WHERE avg_forest_percent > (SELECT avg_forest_percent FROM US_Forest_Percent)
  AND year = 2016;
```