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 **41,282,694.9sqkm** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9sqkm**, a loss of **1,324,449sqkm**, 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 **1,279,999.9891sqkm**).

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**
Europe & Central Asia	**37.28**	**38.04**
North America	**35.65**	**36.04**
World	**32.42**	**31.38**
Sub-Saharan Africa	**30.67**	**28.79**
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 and Caribbean (dropped from 51.03% to 46.16%) 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 sqkm**. 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 **79200.00 sqkm**, 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 **313.66%** 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**	**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 **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 **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:

Country	Region	Pct Designated as Forest
American Samoa	**East Asia & Pacific**	**87.50**
Gabon	**Sub-Saharan Africa**	**90.04**
Guyana	**Latin America & Caribbean**	**83.90**
Lao PDR	**East Asia & Pacific**	**82.11**
Micronesia, Fed. Sts.	**East Asia & Pacific**	**91.86**
Palau	**East Asia & Pacific**	**87.61**
Seychelles	**Sub-Saharan Africa**	**88.41**
Solomon Islands	**East Asia & Pacific**	**77.86**

Suriname	**Latin America & Caribbean**	**98.26**

4. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.

- ***What have you learned from the World Bank data?***
  Using the World Bank database, I explored various scenarios by examining each country's total area and forest coverage from 1990 to 2016. During this period, forestation trends varied significantly across different regions. Notably, Latin America & the Caribbean, Europe & Central Asia, and North America saw substantial increases in forested areas. Conversely, South Asia and East Asia & the Pacific experienced minimal growth, with the Middle East & North Africa lagging significantly at just 2.07% growth.
  Given these findings, it's crucial to direct more attention and resources to the Middle East & North Africa, as well as East Asia & the Pacific. We need to provide clear guidelines on how these regions can enhance their forestation efforts. This involves educating these countries about the vital role of forests in mitigating global warming, improving air quality, and supporting overall environmental health.
  To address this, awareness campaigns should be organized to inform the public about the importance of forests and encourage proactive measures to increase forest coverage.
- ***Which countries should we focus on over others?***
  We need to prioritize China, the United States, India, and the Russian Federation, as these countries have seen minimal growth in forest areas compared to others. These nations are often more focused on land use and commercial interests, which impacts their forest expansion.

5. APPENDIX: SQL Queries Used

```
CREATE VIEW forestation AS
SELECT fra.country_code,
fra.country_name,
fra.year,
fra.forest_area_sqkm,
lda.total_area_sq_mi,
lda.total_area_sq_mi*2.59 total_area_sqkm,
reg.region,
reg.income_group,
(fra.forest_area_sqkm/(lda.total_area_sq_mi*2.59))*100 AS forest_percent
FROM forest_area AS fra
JOIN land_area AS lda
ON fra.country_code = lda.country_code
AND fra.year = lda.year
```

```
JOIN regions reg
ON reg.country_code = lda.country_code
GROUP BY fra.country_code,
fra.country_name,
fra.year,
reg.country_name,
fra.year,
reg.income_group,
reg.region,
lda.total_area_sq_mi,
fra.forest_area_sqkm;
```

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 SUM(forest_area_sqkm) AS total_area_of_forest
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 SUM(forest_area_sqkm) AS total_area_of_forest
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?

```
SELECT (
    (SELECT SUM(forest_area_sqkm) AS total_forest_area
     FROM forestation
     WHERE YEAR = 1990
     AND country_name = 'World') -
    (SELECT SUM(forest_area_sqkm) AS total_forest_area
FROM forestation
WHERE YEAR = 2016
AND country_name = 'World')) AS Change_in_Forest_Area
FROM Forestation
LIMIT 1;
```

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

```
SELECT ((((SELECT SUM(forest_area_sqkm) AS total_forest_area
FROM forestation
WHERE YEAR = 1990
AND country_name = 'World')-
(SELECT SUM(forest_area_sqkm) AS total_forest_area
FROM forestation
WHERE YEAR = 2016
AND country_name = 'World')) / (
(SELECT SUM(forest_area_sqkm) AS total_forest_area
FROM forestation
```

```
WHERE YEAR = 1990
AND country_name='World')))*100) AS
Percent_Change_in_Forest_Area
FROM forestation
LIMIT 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,
SUM(total_area_sq_mi*2.59) AS total_area_of_land
FROM forestation
WHERE YEAR = 2016
AND total_area_sq_mi*2.59 <= 1324449
GROUP BY country_name
ORDER BY total_area_of_land DESC
LIMIT 1;
```

REGIONAL OUTLOOK

2a(i). What was the percent forest of the entire world in 2016?

```
SELECT country_name, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest_Area2016
FROM forestation
WHERE YEAR = 2016
AND country_name = 'World'
GROUP BY country_name
```

2a(ii). Which region had the HIGHEST percent forest in 2016, and which had the LOWEST, to 2 decimal places?

```
(SELECT region, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest_Area2016
FROM forestation
WHERE YEAR = 2016
GROUP BY region
ORDER BY Percent_Forest_Area2016 DESC
LIMIT 1)
UNION ALL
(SELECT region, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest_Area2016
FROM forestation
WHERE YEAR = 2016
```

```
GROUP BY region
ORDER BY Percent_Forest_Area2016 ASC
LIMIT 1);
```

2b(i). What was the percent forest of the entire world in 1990?

```
SELECT country_name, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric,2) AS Percent_Forest_Area1990
FROM Forestation
WHERE YEAR = 1990
AND country_name = 'World'
GROUP BY country_name
```

2b(ii). 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) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest_Area1990
FROM forestation
WHERE YEAR = 1990
GROUP BY region
ORDER BY Percent_Forest_Area1990 DESC
LIMIT 1)
UNION ALL
(SELECT region, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric, 2) AS Percent_Forest_Area1990
FROM forestation
WHERE YEAR = 1990
GROUP BY region
ORDER BY Percent_Forest_Area1990 ASC
LIMIT 1);
```

2c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

```
WITH T1 AS
(SELECT region, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric,2) AS Percent_Forest_Area1990
FROM forestation
WHERE YEAR = 1990 GROUP BY region
ORDER BY Percent_Forest_Area1990 DESC),
T2 AS
```

```
(SELECT region, Round(((SUM(forest_area_sqkm) /
SUM(total_area_sq_mi*2.59))*100)::Numeric,2) AS Percent_Forest_Area2016
FROM forestation
WHERE YEAR = 2016 GROUP BY region
ORDER BY Percent_Forest_Area2016 DESC)
SELECT fra. region, fra. Percent_Forest_Area1990, tra. Percent_Forest_Area2016
FROM T1 AS fra
JOIN T2 AS tra
ON fra. region = tra. region
WHERE fra. Percent_Forest_Area1990>tra. Percent_Forest_Area2016
GROUP BY fra. region, fra. Percent_Forest_Area1990, tra. Percent_Forest_Area2016
LIMIT 2;
```

COUNTRY-LEVEL DETAIL

3a. 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 t1 AS (
SELECT country_code,
country_name,
region,
forest_area_sqkm
FROM forestation
WHERE year = 1990
),
t2 AS (
SELECT country_code,
country_name,
forest_area_sqkm
FROM forestation
WHERE year = 2016
)
SELECT t1.country_name,
t1.region,
t1.forest_area_sqkm AS forest_area_1990,
t2.forest_area_sqkm AS forest_area_2016,
ROUND(
(t2.forest_area_sqkm - t1.forest_area_sqkm)::NUMERIC,
2
) AS change
FROM t1
JOIN t2 ON t1.country_code = t2.country_code
WHERE t1.country_name NOT LIKE 'World'
```

```
ORDER BY change
LIMIT 5;
```

3b. 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 forest_data AS (
   SELECT country_name, region, year, ROUND(forest_area_sqkm::NUMERIC, 2) AS
forest_area
   FROM forestation
   WHERE year IN (1990, 2016)
   AND country_name != 'World'
)
SELECT f1.country_name, f1.region,
      f1.forest_area AS Percent_Forest_Area1990,
      f2.forest_area AS Percent_Forest_Area2016,
      (f1.forest_area - f2.forest_area) AS Difference_Land_Area,
      ROUND(((f1.forest_area - f2.forest_area) / f1.forest_area) * 100, 2) AS
Difference_Percentage_Land_Area
FROM forest_data f1
JOIN forest_data f2
ON f1.country_name = f2.country_name
AND f1.year = 1990
AND f2.year = 2016
AND f1.forest_area IS NOT NULL
AND f2.forest_area IS NOT NULL
ORDER BY Difference_Percentage_Land_Area DESC
LIMIT 5;
```

3c. 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(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, forest_area_sqkm)
SELECT Distinct(quartiles), count(country_name)
      Over(PARTITION BY quartiles)
FROM
     (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
AND YEAR = 2016) sub
```

3d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

```
WITH T1 AS
(SELECT country_name, YEAR,
    (SUM(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, forest_area_sqkm)
SELECT Distinct(quartiles), count(country_name)
      Over(PARTITION BY quartiles)
FROM
(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
AND YEAR = 2016) sub
```

3e. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

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

3f. How many countries had a percent forestation higher than the United States in 2016?

```
SELECT count(*)
FROM forestation
WHERE forest_percent > (SELECT forest_percent FROM forestation WHERE country_name =
'United States' AND year = 2016) AND year = 2016;
```