Report for Forest Query 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	51.02998	46.162072
Middle East & North Africa	1.77524	2.068265
Sub-Saharan Africa	30.67415	28.78819
East Asia & Pacific	25.77610	26.35868
Europe & Central Asia	37.28394	38.04142
North America	35.65118	36.03936
South Asia	16.51077	17.50586

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%) 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 527,229.06sqkm. 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 79200sqkm, 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	541,510 km^2
Indonesia	East Asia & Pacific	282,193.98 km^2
Myanmar	East Asia & Pacific	107,234 km^2
Nigeria	Sub-Saharan Africa	106,506 km^2
Tanzania	Sub-Saharan Africa	102,320 km^2

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 %
Ugnada	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 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
1st	85
2nd	72
3rd	38
4th	9

The largest number of countries in 2016 were found in the 1st 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 & Pacifc	87.61
American Samoa	East Asia & Pacific	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

5. RECOMMENDATIONS

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

- ***What have you learned from the World Bank data?***

This data has extensively shown that the situation around global forestation is not favorable between 1991 to 2016. Even though if we make consideration at country level, some countries like China and United States have improved statistics within this period. Hence, it is highly recommended for countries and regions more affected (Latin America & Caribbean and Sub-Saharan Africa) to learn more from China and United States. East Asia Pacific region host most of the world's countries with the highest forest percentage area with more than 75% forest designated area. Only two countries from sub-Saharan African (Gabon and Seychelles) are in the category above 75% of forest designated area.

- ***Which countries should we focus on over others?***

It is clearly ideal from the results to concentrate all efforts and resources on countries that had the largest forest area decrease in terms of the (a) percentage decrease and (b) amount decrease.
Based on percentage decrease (Table 3.2) are Togo, Nigeria, Uganda, Mauritania, & Honduras.
Based on amount decrease (Table 3.1) are Brazil, Indonesia, Myanmar, Nigeria, & Tanzania.
Additionally, I am of the opinion that Nigeria should be given a special consideration among the list above because it has experienced decrease both in terms of percentage and amount of forest area.

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_name, Round(SUM(forest_area_sqkm)) AS Forest_Area1990
FROM forestation
WHERE YEAR = 1990
GROUP BY country_name, forest_area_sqkm
ORDER BY Forest_Area1990 DESC),

T2 AS
        (SELECT country_name, Round(SUM(forest_area_sqkm)) AS Forest_Area2016
FROM forestation
WHERE YEAR = 2016
GROUP BY country_name, forest_area_sqkm
ORDER BY Forest_Area2016 DESC)

SELECT fra.country_name, fra.Forest_Area1990, tra. Forest_Area2016,
                (tra.Forest_Area2016-fra.Forest_Area1990) AS Difference_Land_Area
FROM T1 AS fra
JOIN T2 AS tra
ON fra.country_name = tra.country_name
WHERE fra.country_name != 'World'
GROUP BY fra.country_name, tra.Forest_Area2016, fra.Forest_Area1990
ORDER BY Difference_Land_Area
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 T1 AS
        (SELECT country_name, region, Round((forest_area_sqkm)::Numeric,2) AS
                        Percent_Forest_Area1990
FROM forestation
WHERE YEAR = 1990
GROUP BY country_name, region, forest_area_sqkm),

T2 AS
        (SELECT country_name, region, Round((forest_area_sqkm)::Numeric,2) AS
                Percent_Forest_Area2016
FROM forestation
WHERE YEAR = 2016
GROUP BY country_name, region, forest_area_sqkm)

SELECT fra.country_name, fra.region, fra.Percent_Forest_Area1990,
                tra.Percent_Forest_Area2016,                    (fra.Percent_Forest_Area1990-
                tra.Percent_Forest_Area2016)            AS              Difference_Land_Area,
                (((fra.Percent_Forest_Area1990-
                tra.Percent_Forest_Area2016)/fra.Percent_Forest_Area1990)*100)          AS
                Difference_Percentage_Land_Area
FROM T1 AS fra
JOIN T2 AS tra
ON fra.country_name = tra.country_name
WHERE fra.Percent_Forest_Area1990 IS NOT NULL
AND tra.Percent_Forest_Area2016 IS NOT NULL
AND fra.country_name != 'World'
GROUP BY fra.country_name, fra.region, fra.Percent_Forest_Area1990,
                        tra.Percent_Forest_Area2016
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
```