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 sq.km** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.90 sq.km**, a loss of **1324449 sq.km**, 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 **1,279,999.99 sq.km**).

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
World	32.42%	31.38%
Latin America & Caribbean	51.03%	46.16%
Europe and Central Asia	37.28%	38.04%
North America	35.65%	36.04%
Sub-Saharan Africa	30.37%	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 & Caribbean** (dropped from **51.03%** to **46.16%**) and **Sub-Saharan Africa** (**30.37%** 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 **527,229.06 sq.km**. 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 sq.km**, 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 sq.km
Indonesia	East Asia & Pacific	282,193.9844 sq.km
Myanmar	East Asia & Pacific	107,234.0039 sq.km
Nigeria	Sub-Saharan Africa	106,506.00098 sq.km
Tanzania	Sub-Saharan Africa	102,320 sq.km

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	59.27%
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%	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	98.26
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	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
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?*

Even though the percentage of forest areas has been decreasing throughout the World (from 32.42% in 1990 to 31.38% in 2016, Table 2.1), the majority of regions have had an increase in the overall percentage of forest areas, such as Europe and Central Asia, North America, East Asia & Pacific, South Asia, and the Middle East & North Africa. Only two regions have seen a decline: Latin America & Caribbean (51.03% in 1990 to 46.16% in 2016, Table 2.1), and Sub-Saharan Africa (30.37% in 1990 to 28.79% in 2016, Table 2.1). The two larger developed countries, China and the United States, have seen the most increase in forest areas from 1990 to 2016, 527,229.06 sq.km and 79,200 sq.km respectively. Though when we take a closer look at the percentage of forest area change through a regional lens, the Sub-Saharan Africa region has four countries in the top five countries with decreasing forest area: Togo, Nigeria, Uganda, and Mauritania (table 3.2).

We should focus on China and the United States assisting the five countries that have the most absolute forest area change, which are: Brazil, Indonesia, Myanmar, Nigeria, and Tanzania (table 3.1). Three of these five countries are within the only two regions that have seen a decrease in forest area: Brazil within the Latin America & Caribbean region, and Nigeria and Tanzania within the Sub-Saharan Africa region. Reducing the absolute forest area change in these countries will translate to a lower percentage of forest area change in the World.

5. APPENDIX: SQL Queries Used

View Creation:

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW Forestation AS

SELECT f.country_code, f.country_name, f.year, f.forest_area_sqkm, (total_area_sq_mi*2.59)
AS total_area_sqkm, r.region, r.income_group, ((Sum(forest_area_sqkm) /
Sum(total_area_sq_mi2.59))100) percentage_forest

FROM forest_area f

JOIN land_area l

ON f.country_code = l.country_code AND f.year = l.year

JOIN regions r

ON r.country_code = f.country_code

GROUP BY f.country_code, f.country_name, f.year, f.forest_area_sqkm, r.region,
r.income_group, total_area_sq_mi*2.59
```

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 year, country_name AS country, SUM(forest_area_sqkm) AS total_forest_area_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 1990
```

GROUP BY year, country_name

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 year, country_name AS country, SUM(forest_area_sqkm) AS total_forest_area_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 2016
GROUP BY year, country_name
```

1.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_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 1990) - (SELECT SUM(forest_area_sqkm) AS
total_forest_area_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 2016)) AS difference
FROM forestation
LIMIT 1
```

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_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 1990) -
(SELECT SUM(forest_area_sqkm) AS total_forest_area_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 2016))/
( (SELECT SUM(forest_area_sqkm) AS total_forest_area_sqkm
FROM forestation f
WHERE country_name = 'World' AND year = 1990)))*100) AS percent_decrease
```

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_sqkm) AS total_area_sqkm
FROM forestation
WHERE year = 2016 AND total_area_sqkm IS NOT NULL AND total_area_sqkm BETWEEN
1200000 AND 1324449
GROUP BY country_name, total_area_sqkm
ORDER BY total_area_sqkm DESC
LIMIT 1
```

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?

```
–World 2016
SELECT country_name, ROUND(CAST(percentage_forest AS Numeric), 2) AS percent_forest
FROM forestation
WHERE country_name = 'World' AND year = 2016


–highest 2016
SELECT region, ROUND(CAST((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
NUMERIC), 2) AS percentage_forest
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percentage_forest DESC
LIMIT 1


–lowest 2016
SELECT region, ROUND(CAST((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
NUMERIC), 2) AS percentage_forest
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percentage_forest
LIMIT 1
```

2.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?

```
–World 1990
SELECT country_name, ROUND(CAST(percentage_forest AS NUMERIC), 2) AS
percent_forest
FROM forestation
WHERE country_name = 'World' AND year = 1990


–highest 1990
SELECT region, ROUND(CAST((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
NUMERIC), 2) AS percentage_forest
```

```
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY percentage_forest DESC
LIMIT 1


–lowest 1990
SELECT region, ROUND(CAST((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
NUMERIC), 2) AS percentage_forest
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY percentage_forest
LIMIT 1
```

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

```
–table 1990
SELECT region, ROUND(CAST((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
NUMERIC), 2) AS percentage_forest
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY percentage_forest DESC


–table 2016
SELECT region, ROUND(CAST((SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
NUMERIC), 2) AS percentage_forest
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percentage_forest DESC
```

3.A Success Stories

```
–Increased total forest area
WITH T1 AS
(SELECT country_name, SUM(forest_area_sqkm) AS forest_area_90
FROM forestation
```

```
WHERE year = 1990 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
Group BY country_name, forest_area_sqkm),
T2 AS
(SELECT country_name, SUM(forest_area_sqkm) AS forest_area_16
FROM forestation
WHERE year = 2016 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
GROUP BY country_name, forest_area_sqkm)
SELECT f.country_name, (f.forest_area_90 - t.forest_area_16) AS forest_change
FROM T1 f
JOIN T2 t
ON f.country_name = t.country_name
ORDER BY forest_change


–increased total forest area percentage
WITH T1 AS
(SELECT country_name, (SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
forest_percent_1
FROM forestation
WHERE year = 1990 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
Group BY country_name, forest_area_sqkm),
T2 AS
(SELECT country_name, (SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
forest_percent_2
FROM forestation
WHERE year = 2016 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
GROUP BY country_name, forest_area_sqkm)
SELECT f.country_name,
ROUND(CAST(((f.forest_percent_1-t.forest_percent_2)/(f.forest_percent_1))*100 AS
NUMERIC), 2) AS percent_change
FROM T1 f
JOIN T2 t
ON f.country_name = t.country_name
ORDER BY percent_change
```

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?

```
–largest decrease amount
WITH T1 AS
(SELECT country_name, region, SUM(forest_area_sqkm) AS forest_area_90 FROM forestation
```

```
WHERE year = 1990 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
Group BY country_name, region, forest_area_sqkm),
T2 AS
(SELECT country_name, region, SUM(forest_area_sqkm) AS forest_area_16
FROM forestation
WHERE year = 2016 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
GROUP BY country_name, region, forest_area_sqkm)
SELECT f.country_name, f.region, (f.forest_area_90 - t.forest_area_16) AS forest_change
FROM T1 f
JOIN T2 t
ON f.country_name = t.country_name
ORDER BY forest_change DESC
LIMIT 5
```

3.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?

```
–largest decrease percentage
WITH T1 AS
(SELECT country_name, region,(SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
forest_percent_1
FROM forestation
WHERE year = 1990 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
Group BY country_name, region, forest_area_sqkm),
T2 AS
(SELECT country_name, region, (SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
forest_percent_2
FROM forestation
WHERE year = 2016 AND country_name <> 'World' AND forest_area_sqkm IS NOT NULL
GROUP BY country_name, region, forest_area_sqkm)
SELECT f.country_name, f.region,
ROUND(CAST(((f.forest_percent_1-t.forest_percent_2)/(f.forest_percent_1))*100 AS
NUMERIC), 2) AS percent_change
FROM T1 f
JOIN T2 t
ON f.country_name = t.country_name
WHERE f.forest_percent_1 IS NOT NULL AND t.forest_percent_2 IS NOT NULL
ORDER BY percent_change DESC
LIMIT 5
```

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

```
–quartiles
WITH T1 AS
(SELECT country_name, year, (SUM(forest_area_sqkm)/SUM(total_area_sqkm))*100 AS
forest_percent
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 forest_percent < 25 THEN '0-25'
WHEN forest_percent >= 25 AND forest_percent <50 THEN '25-50'
WHEN forest_percent >= 50 AND forest_percent < 75 THEN '50-75'
ELSE '75-100'
END AS quartiles
FROM T1
WHERE forest_percent IS NOT NULL AND year = 2016) AS x
```

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

```
–4th quartile
WITH T2 AS
(WITH T1 AS
(SELECT country_name, region,
year,
(SUM(forest_area_sqkm) / SUM(total_area_sqkm))*100 forest_percent
FROM forestation
WHERE year = 2016
GROUP BY country_name, region,
year,
forest_area_sqkm) SELECT Distinct(quartiles),
count(country_name)Over(PARTITION BY quartiles),
country_name, region,
forest_percent
FROM
(SELECT country_name, region,
forest_percent,
CASE
```

```
WHEN forest_percent<=25 THEN '0-25'
WHEN forest_percent>25
AND forest_percent<=50 THEN '25-50'
WHEN forest_percent>50
AND forest_percent<=75 THEN '50-75'
ELSE '75-100'
END AS quartiles
FROM T1
WHERE forest_percent IS NOT NULL
AND YEAR = 2016) AS x)
SELECT country_name, region,
quartiles,
Round(CAST(forest_percent AS NUMERIC), 2) forest_percent
FROM T2
WHERE quartiles = '75-100'
ORDER BY forest_percent DESC
```