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 **41,282,694.9 sq km** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9 sq km**, a loss of **1,324,449 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 percentage of the total land area of the world designated as forest was **31.4%**. The region with the highest relative forestation was **Latin America & Caribbean**, with **46.2%**, and the region with the lowest relative forestation was **Middle East & North Africa**, with **2.1%** forestation.

In 1990, the percentage of the total land area of the world designated as forest was **32.4%**. The region with the highest relative forestation was **Latin America & Caribbean**, with **51%**, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.8%** forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016:

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51	46.2
Europe & Central Asia	37.3	38
North America	35.7	36
Sub-Saharan Africa	30.7	28.8
East Asia & Pacific	25.8	26.4
South Asia	16.5	17.5
Middle East & North Africa	1.8	2.1

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America & Caribbean** (dropped from **51% to 46.2%**) and **Sub-Saharan Africa** (**30.7% to 28.8%**). 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 **32.2% to 31.4%**.

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 increased by **213.7%** 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	282,193.98 sq km
Myanmar	East Asia & Pacific	107,234.00 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	75.44%
Nigeria	Sub-Saharan Africa	61.80%
Uganda	Sub-Saharan Africa	59.13%

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
1	86
2	74
3	36
4	9

The largest number of countries in 2016 were found in the **1st** quartile.

There were **nine (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

5. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.
What have you learned from the World Bank data?

- There is a total of **217** countries available in the World Bank data.
- The country with the largest forest area in 2016 is **Russia Federation** with **8,148,895 sq km**
- The country with the smallest forest area in 2016 is **Faroe Islands** with **0.8 sq km**
- Only **32** countries experienced no change in forestation from 1990 to 2016
- **94** countries had a percentage forestation higher than the **United States** in 2016 (i.e. > **33.93%**)
- 4 countries witnessed massive forestation in 2016 (with more than twice the forest area they had in 1990) these countries include: **Iceland**, **French Polynesia**, **Bahrain** and **Uruguay**

Which countries should we focus on over others?

We can focus on the countries that ranked in the 1st quartile. The table below shows the number of countries ranked in the 1st quartile and their respective countries

Region	Number of Countries
East Asia & Pacific	6
Sub-Saharan Africa	22
South Asia	6
Latin America & Caribbean	9
Europe & Central Asia	22
Middle East & North Africa	20
North America	1

Additionally, as earlier seen, the top 3 percent decrease in Forest Area by Country, 1990 & 2016 were countries in the **Sub-Saharan Africa** region, **Togo**, **Nigeria** and **Uganda**. This indicates that the **Sub-Saharan Africa** region should be the focus of curbing deforestation as

the total area of land relative to the forest area is quite low when compared to countries like **Iceland** or **Bahrain** who grew more forest in 2016.

6. APPENDIX

```
-- Create deforestation view
CREATE VIEW deforestation
AS
(
		SELECT fa.country_code AS country_code
			,fa.country_name AS country_name
			,fa.year AS year
			,fa.forest_area_sqkm AS forest_area_sqkm
			,la.total_area_sq_mi * 2.59 AS total_area_sqkm
			,fa.forest_area_sqkm / (la.total_area_sq_mi * 2.59) * 100 AS
percentage_forest
			,r.region AS region
			,r.income_group AS income_group
		FROM forest_area fa
		FULL JOIN land_area la ON fa.country_code = la.country_code
			AND fa.year = la.year
		FULL JOIN regions r ON r.country_code = fa.country_code
		)

-- Total forest area of the world in 1990
SELECT forest_area_sqkm
FROM deforestation
WHERE year = 1990 AND country_name = 'World';

-- Total forest area of the world in 2016
SELECT forest_area_sqkm
FROM deforestation
WHERE year = 2016 AND country_name = 'World';

-- Difference in forest area of the world between 2016 and 1990
SELECT (
		SELECT forest_area_sqkm
		FROM deforestation
		WHERE year = 2016 AND country_name = 'World'
		) - (
		SELECT forest_area_sqkm
```

```
                FROM deforestation
                WHERE year = 1990 AND country_name = 'World'
                ) AS difference
FROM deforestation limit 1;

-- % Difference in forest area of the world between 2016 and 1990

--
WITH deforestation_2016
AS (
        SELECT *
        FROM deforestation
        WHERE year = 2016
        )
SELECT country_name
        ,total_area_sqkm
FROM deforestation_2016
WHERE total_area_sqkm < 2191038.09
ORDER BY 2 DESC;

-- What was the percent forest of the entire world in 2016?

SELECT percentage_forest
FROM deforestation
WHERE country_name = 'World'
        AND year = 2016;

-- What was the percent forest of the entire world in 1990?

SELECT percentage_forest
FROM deforestation
WHERE country_name = 'World'
        AND year = 1990;

-- The region with the highest relative forestation 2016
SELECT region AS Region
        ,(sum(forest_area_sqkm) / sum(total_area_sqkm)) * 100 AS Relative_Forestation
FROM deforestation
WHERE year = 2016
        AND country_name != 'World'
GROUP BY 1
ORDER BY 2 DESC;
```

```
-- The region with the highest relative forestation 1990
SELECT region AS Region
	,(sum(forest_area_sqkm) / sum(total_area_sqkm)) * 100 AS Relative_Forestation
FROM deforestation
WHERE year = 1990
	AND country_name != 'World'
GROUP BY 1
ORDER BY 2 DESC;

-- Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?

SELECT t1.Country
	,t1.forest_area AS Forest_Area_1990
	,t1.forest_area_2016 AS Forest_Area_2016
	,t1.forest_area_2016 - t1.forest_area AS Forest_Decrease
FROM (
	SELECT country_name AS Country
		,year AS Year
		,forest_area_sqkm AS Forest_Area
		,lead(forest_area_sqkm) OVER (
			PARTITION BY country_name ORDER BY year
			) AS Forest_Area_2016
	FROM deforestation
	WHERE year = 1990
		OR year = 2016
		AND country_name != 'World'
		AND percentage_forest IS NOT NULL
	ORDER BY 1
		,2
	) t1
WHERE year = 1990
	AND t1.forest_area_2016 - t1.forest_area IS NOT NULL
ORDER BY 4 DESC;

-- Which 5 countries saw the largest percent decrease in forest area from 1990 to 2016? What was the percentage change for each?

SELECT t1.Country
	,t1.forest_area AS Forest_Area_1990
	,t1.forest_area_2016 AS Forest_Area_2016
	,t1.forest_area_2016 - t1.forest_area AS Forest_Decrease
```

```
	,ABS(((t1.forest_area_2016 - t1.forest_area) / t1.forest_area) * 100) AS
Percentage_Decrease
FROM (
	SELECT country_name AS Country
		,year AS Year
		,forest_area_sqkm AS Forest_Area
		,lead(forest_area_sqkm) OVER (
			PARTITION BY country_name ORDER BY year
			) AS Forest_Area_2016
	FROM deforestation
	WHERE year = 1990
		OR year = 2016
		AND country_name != 'World'
		AND percentage_forest IS NOT NULL
	ORDER BY 1
		,2
	) t1
WHERE year = 1990
	AND t1.forest_area_2016 - t1.forest_area IS NOT NULL
ORDER BY 5;

-- Create percentage forestation view
CREATE VIEW percentage_forestation
AS
(
		SELECT t1.Country
			,t1.forest_area AS Forest_Area_1990
			,t1.forest_area_2016 AS Forest_Area_2016
			,t1.forest_area_2016 - t1.forest_area AS Forest_Decrease
			,((t1.forest_area_2016 - t1.forest_area) / t1.forest_area) * 100 AS
Percentage_Decrease
		FROM (
			SELECT country_name AS Country
				,year AS Year
				,forest_area_sqkm AS Forest_Area
				,lead(forest_area_sqkm) OVER (
					PARTITION BY country_name ORDER BY year
					) AS Forest_Area_2016
			FROM deforestation
			WHERE year = 1990
				OR year = 2016
				AND country_name != 'World'
				AND percentage_forest IS NOT NULL
```

```
                ORDER BY 1
                        ,2
                ) t1
        WHERE year = 1990
                AND t1.forest_area_2016 - t1.forest_area IS NOT NULL
        ORDER BY 4 DESC
        )

-- If countries were grouped by percentage forestation in quartiles, which group had the most
countries in it in 2016?
SELECT t2.rank
        ,count(t2.rank)
FROM (
        SELECT t1.region AS Region
                ,t1.country_name AS Country
                ,round(t1.percentage_forest::NUMERIC, 2) AS Percentage_Forest
                ,CASE
                        WHEN round(t1.percentage_forest::NUMERIC, 0) > 76
                                THEN 4
                        WHEN round(t1.percentage_forest::NUMERIC, 0) BETWEEN 51
                                        AND 75
                                THEN 3
                        WHEN round(t1.percentage_forest::NUMERIC, 0) BETWEEN 26
                                        AND 50
                                THEN 2
                        ELSE 1
                        END AS Rank
        FROM (
                SELECT *
                FROM deforestation
                WHERE year = 2016
                        AND percentage_forest IS NOT NULL
                ) t1
        ) t2
GROUP BY 1
ORDER BY 1


-- List all of the countries that were in the 4th quartile (percentage forest > 75%) in 2016
WITH country_rank
AS (
        SELECT t1.region AS Region
                ,t1.country_name AS Country
```

```
		,round(t1.percentage_forest::NUMERIC, 2) AS Percentage_Forest
		,CASE
			WHEN round(t1.percentage_forest::NUMERIC, 0) > 76
				THEN 4
			WHEN round(t1.percentage_forest::NUMERIC, 0) BETWEEN 51
					AND 75
				THEN 3
			WHEN round(t1.percentage_forest::NUMERIC, 0) BETWEEN 26
					AND 50
				THEN 2
			ELSE 1
			END AS Rank
	FROM (
		SELECT *
		FROM deforestation
		WHERE year = 2016
			AND percentage_forest IS NOT NULL
		) t1
	)
SELECT country
	,percentage_forest
FROM country_rank
WHERE rank = 4
ORDER BY 2 DESC;

-- How many countries had a percentage forestation higher than the United States in 2016?

SELECT country_name AS Country
	,round(percentage_forest::NUMERIC, 2) AS Percentage_Forestation
FROM deforestation
WHERE round(percentage_forest::NUMERIC, 2) > (
		SELECT round(percentage_forest::NUMERIC, 2)
		FROM deforestation
		WHERE country_name = 'United States'
			AND year = 2016
		)
	AND year = 2016
ORDER BY 2;

-- Exploratory Analysis of the dataset
SELECT count(DISTINCT (country_name))
FROM deforestation
WHERE country_name IS NOT NULL
```

```
	AND country_name != 'World';

SELECT *
FROM percentage_forestation
WHERE round(percentage_decrease::NUMERIC, 2) > 100
ORDER BY 5 DESC;

SELECT country
	,min(forest_area_2016)
FROM percentage_forestation
GROUP BY 1
ORDER BY 2 limit 1;

SELECT country
	,max(forest_area_2016)
FROM percentage_forestation
GROUP BY 1
ORDER BY 2 DESC limit 1;

SELECT t2.region AS Region
	,count(t2.country) AS Num_of_countries
FROM (
	SELECT t1.region AS Region
		,t1.country_name AS Country
		,round(t1.percentage_forest::NUMERIC, 2) AS Percentage_Forest
		,CASE
			WHEN round(t1.percentage_forest::NUMERIC, 0) > 76
				THEN 4
			WHEN round(t1.percentage_forest::NUMERIC, 0) BETWEEN 51
					AND 75
				THEN 3
			WHEN round(t1.percentage_forest::NUMERIC, 0) BETWEEN 26
					AND 50
				THEN 2
			ELSE 1
			END AS Rank
	FROM (
		SELECT *
		FROM deforestation
		WHERE year = 2016
			AND percentage_forest IS NOT NULL
		) t1
	) t2
```

```
WHERE rank = 1
GROUP BY 1
```