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.

TABLE OF CONTENTS

1. **GLOBAL SITUATION**

According to the World Bank, the total forest area of the world was 41282694.9 km² in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km², a loss of 1324449 km², 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 494208.49 mi²).

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
World	32.42	31.38
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 (32.19% to 28.30%). 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 km². 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 km² , 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 km²
Indonesia	East Asia & Pacific	-282193.98 km²
Myanmar	East Asia & Pacific	-107234.00 km²
Nigeria	Sub-Saharan Africa	-106506.00 km²
Tanzania	Sub-Saharan Africa	-102320.00 km²

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	-59.13
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
1	85
2	72
3	38
4	9

The largest number of countries in 2016 were found in the first quartile.

There were nine 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

Summary of Insights from World Bank Data:

The analysis of World Bank data reveals a noteworthy trend — the forest share in many countries has increased since 1990. This positive development suggests global efforts toward sustainable forestry and environmental conservation.

However, our focus should be particularly directed towards countries that have experienced a significant percentage loss in forest area since 1990. Importantly, our emphasis is not solely on the percentage decline but primarily on countries where the absolute quantity of forest area has seen the most substantial reduction in terms of land area.

This strategic approach enables us to target countries where the actual expanse of forests has markedly decreased since 1990. By concentrating efforts on these countries, we can formulate precise interventions aimed at reversing the negative trend and promoting sustainable forest management.

The insights derived from the data provide an opportunity to allocate resources effectively and implement actions that can make a significant impact on forest preservation and restoration. This focused strategy allows us to develop tailored measures to address the specific challenges faced by countries witnessing a substantial decline in forest area, contributing to a more impactful global conservation effort.

5. APPENDIX: SQL Queries Used

```sql
-- Create a common table for global forest data
WITH world_forest_data AS (
        SELECT
                country_name,
                MAX(CASE WHEN "year" = 1990 THEN forest_area_sqkm END) AS
forest_area_1990_sqkm,
                MAX(CASE WHEN "year" = 2016 THEN forest_area_sqkm END) AS
forest_area_2016_sqkm,
                -- Calculate forest loss in square kilometers
                (MAX(CASE WHEN "year" = 1990 THEN forest_area_sqkm END) - MAX(CASE
WHEN "year" = 2016 THEN forest_area_sqkm END)) AS forest_area_loss_sqkm,
                -- Calculate the percentage of forest loss
                100 * (1 - MAX(CASE WHEN "year" = 2016 THEN forest_area_sqkm END) /
MAX(CASE WHEN "year" = 1990 THEN forest_area_sqkm END)) AS percentage_loss
        FROM public.forest_area
        WHERE country_name = 'World' AND "year" IN (1990, 2016)
        GROUP BY country_name
)

-- Overall query for global forest data and country land areas
SELECT
        -- Global forest data
        wf.forest_area_1990_sqkm,
        wf.forest_area_2016_sqkm,
        wf.forest_area_loss_sqkm,
        wf.percentage_loss,
        -- Country land area data
        la.country_name AS land_area_country,
        la.total_area_sq_mi AS land_area_sq_mi
FROM world_forest_data wf
JOIN land_area la ON la.total_area_sq_mi < wf.forest_area_loss_sqkm * 0.386102 AND la.year
= 2016
-- Sort results by country land area in descending order
ORDER BY la.total_area_sq_mi DESC
-- Return only the top result
LIMIT 1;
```

```sql
-- Common Table Expression (CTE) to aggregate data for 1990 and 2016 by region
WITH CTE AS (
        SELECT
        r.region AS region,
        -- Calculate total land area in 1990 and 2016
        SUM(CASE WHEN la."year" = 1990 THEN la.total_area_sq_mi * 2.59 END) AS
land_1990,
        SUM(CASE WHEN la."year" = 2016 THEN la.total_area_sq_mi * 2.59 END) AS
land_2016,
        -- Calculate total forest area in 1990 and 2016
        SUM(CASE WHEN la."year" = 1990 THEN fa.forest_area_sqkm END) AS forest_1990,
        SUM(CASE WHEN la."year" = 2016 THEN fa.forest_area_sqkm END) AS forest_2016
        FROM
        land_area la
        JOIN
        forest_area fa ON
                la."year" = fa."year"
                AND la.country_code = fa.country_code
                AND la."year" IN (1990, 2016)
                AND fa.forest_area_sqkm IS NOT NULL
                AND la.total_area_sq_mi IS NOT NULL
        JOIN
        regions r ON la.country_code = r.country_code
        -- Filter for regions with data for both 1990 and 2016
        GROUP BY
        fa.country_code, fa.country_name, r.region
        HAVING COUNT(DISTINCT la."year") = 2
)
-- Select and calculate forest percentage and determine if there's a decrease from 1990 to 2016
SELECT
        region,
        -- Round forest percentage values to two decimal places using CAST
        CAST(100*SUM(forest_1990)/SUM(land_1990) AS NUMERIC(10,2)) AS
forest_percent_1990,
        CAST(100*SUM(forest_2016)/SUM(land_2016) AS NUMERIC(10,2)) AS
forest_percent_2016,
        -- Determine if there's a decrease in forest area from 1990 to 2016
        CASE WHEN SUM(forest_1990) > SUM(forest_2016) THEN '1' ELSE '0' END AS
decreased_forest_area
FROM CTE
-- Group results by region
GROUP BY region
-- Order the results by forest percentage in 1990 in descending order
ORDER BY forest_percent_1990 DESC;
```

```sql
-- Common Table Expression (CTE) to compute forest statistics
WITH ForestStatistics AS (
        -- Selecting forest area in 1990, 2016, land area in 2016, and related calculations
        SELECT
                -- Forest area in 1990 with "sqkm" suffix
                CAST(MAX(CASE WHEN fa.year = 1990 THEN fa.forest_area_sqkm END) AS
NUMERIC(10,2)) AS forest_area_1990_sqkm, --1

                -- Forest area in 2016 with "sqkm" suffix
                CAST(MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm END) AS
NUMERIC(10,2)) AS forest_area_2016_sqkm, --2

                -- Land area in 2016 with "sqkm" suffix
                la.land_area_2016_sqkm, --3

                -- Country code
                fa.country_code, --3.5

                -- Country name
                fa.country_name AS Country, --4

                -- Absolute change in forest area with "sqkm" suffix
                CAST(MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm END) -
MAX(CASE WHEN fa.year = 1990 THEN fa.forest_area_sqkm END) AS NUMERIC(9,2)) AS
Absolute_Forest_Area_Change_sqkm, --6

                -- Percentage change in forest area
                CAST((MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm END) *
100 / MAX(CASE WHEN fa.year = 1990 THEN fa.forest_area_sqkm END) - 100) AS
NUMERIC(5,2)) AS Pct_Forest_Area_Change, --7

                -- Percentage of land designated as forest
                CAST((MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm END) *
100 / la.land_area_2016_sqkm) AS NUMERIC(5,2)) AS Pct_Designated_as_Forest, --8

                -- Quartile classification based on the percentage of land designated as forest
                CASE
                        WHEN fa.country_name = 'World' THEN NULL
                        WHEN (MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm
END) * 100 / la.land_area_2016_sqkm) <= 25 THEN 1
                        WHEN (MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm
END) * 100 / la.land_area_2016_sqkm) <= 50 THEN 2
                        WHEN (MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm
END) * 100 / la.land_area_2016_sqkm) <= 75 THEN 3
```

```sql
                ELSE 4
            END AS Quartile --9

    FROM
            -- Source table for forest area data
            Forest_Area fa
    LEFT JOIN (
            -- Subquery to calculate land area in 2016
            SELECT
                    country_name,

                    -- Land area in 2016 converted to square kilometers with "sqkm" suffix
                    ROUND(CAST(MAX(CASE WHEN year = 2016 THEN total_area_sq_mi
END) * 2.59 AS NUMERIC), 2) AS land_area_2016_sqkm --3

                    FROM
                            -- Source table for land area data
                            Land_Area
                    GROUP BY
                            country_name
                    HAVING
                            MAX(CASE WHEN year BETWEEN 1990 AND 2016 THEN
total_area_sq_mi END) IS NOT NULL
            ) la ON fa.country_name = la.country_name
    WHERE
            -- Filtering data for the years 1990 and 2016
            fa.year IN (1990, 2016)
    GROUP BY
            -- Grouping data by land area, country code, and country name
            la.land_area_2016_sqkm, fa.country_code, fa.country_name
    HAVING
            -- Excluding rows where forest area in 2016 is not available
            MAX(CASE WHEN fa.year = 2016 THEN fa.forest_area_sqkm END) IS NOT
NULL
)

-- Main query to retrieve and further analyze forest statistics
SELECT
        -- Selecting columns for the final result set
        forest_area_1990_sqkm, --1
        forest_area_2016_sqkm, --2
        land_area_2016_sqkm, --3
        Country, --4
        r.region, --5
```

```sql
        Absolute_Forest_Area_Change_sqkm, --6
        Pct_Forest_Area_Change, --7
        Pct_Designated_as_Forest, --8
        Quartile, --9

        -- Count of countries within the same quartile
        COUNT(*) OVER (PARTITION BY Quartile) AS Quartile_count,

        -- Indicator comparing the country's forest designation with the USA
        CASE
                WHEN fs.country_code = 'USA' THEN '≙'
                WHEN Pct_Designated_as_Forest > (SELECT Pct_Designated_as_Forest
FROM ForestStatistics WHERE country_code = 'USA') THEN 'yes'
                ELSE 'no'
        END AS higher_than_usa_indicator

FROM
        -- Using the ForestStatistics CTE as the source
        ForestStatistics fs

LEFT JOIN
        -- Joining with the regions table based on the country code
        regions r ON fs.country_code = r.country_code

WHERE
        -- Filtering out the 'World' and rows where forest designation percentage is not available
        Country != 'World' AND Pct_Designated_as_Forest IS NOT NULL

-- Ordering the final result set
ORDER BY
        -- Ordering by percentage designated as forest in descending order
        8 DESC,

        -- Ordering by quartile in descending order (with NULLs last)
        9 DESC NULLS LAST,

        -- Secondary sorting by percentage forest area change
        7,

        -- Tertiary sorting by absolute forest area change
        6;
```