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 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%
East Asia & Pacific	25.77%	26.36%
Europe & Central Asia	37.27%	38.07%
Latin America & Caribbean	51.03%	46.16%
Middle East & North Africa	1.78%	2.07%
North America	35.65%	36.04%
South Asia	16.51%	17.51%
Sub-Saharan Africa	32.19%	28.30%

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 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 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 5 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 (sq km)
Brazil	Latin America & Caribbean	-541,510
Indonesia	East Asia & Pacific	-282,193.98
Myanmar	East Asia & Pacific	-107,234.00
Nigeria	Sub-Saharan Africa	-106,506.00
Tanzania	Sub-Saharan Africa	-102,320

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
0-25%	85
25-50%	72
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

Based on the comprehensive analysis of global deforestation data from 1990 to 2016, the following recommendations are proposed for ForestQuery's strategic initiatives:

Priority Focus Areas:

1. Sub-Saharan Africa - Critical Intervention Needed

- This region demands immediate attention as it shows both significant absolute loss (-3.89% regional decline) and dominates the list of countries with the highest percent forest loss (4 out of 5 top countries).
- Nigeria presents the most critical case, appearing in both top 5 lists for absolute and percent decrease. A targeted intervention program for Nigeria could serve as a model for the region.
- Recommend allocating 40% of resources to Sub-Saharan Africa, with specific focus on Nigeria, Togo, Uganda, and Mauritania.

2. Latin America & Caribbean - Large-Scale Impact Opportunity

- Despite having the highest regional forestation percentage (46.16%), this region experienced the largest absolute decline (-4.87%).
- Brazil alone lost 541,510 sq km, representing the single largest country-level forest loss globally.
- The region's high baseline forestation suggests conservation efforts could prevent catastrophic losses. Recommend 35% resource allocation.

3. East Asia & Pacific - Mixed Results Requiring Strategic Support

- Indonesia and Myanmar show concerning losses, but China demonstrates that dramatic positive change is possible (527,229 sq km increase).
- Study and document China's success story for replication in Indonesia and Myanmar.
- Recommend 15% resource allocation focused on knowledge transfer programs.

Success Story Analysis:

- China's remarkable reforestation success (527,229 sq km increase) and Iceland's percentage growth (213.66%) should be thoroughly studied.
- Develop case studies on their policies, incentives, and implementation strategies for adaptation in countries facing deforestation.
- Consider establishing partnerships with these governments to mentor at-risk countries.

Strategic Initiatives:

- Develop targeted intervention programs for the 85 countries in the 0-25% forestation quartile to prevent further degradation.
- Create a "Nigeria Model" pilot program given its dual ranking in both absolute and percentage decline metrics.
- Establish monitoring systems for the 9 countries in the top quartile (>75% forest) to maintain their success and prevent future losses.
- With 94 countries having higher forestation than the United States (a developed nation), demonstrate that economic development and forest conservation can coexist.

Conclusion: The data clearly indicates that while 1.32 million sq km of forest was lost globally (equivalent to Peru's entire land area), targeted interventions in Sub-Saharan Africa and Latin America & Caribbean could have the most significant impact on reversing global deforestation trends.

5. APPENDIX: SQL Queries Used

1. CREATE FORESTATION VIEW

```
CREATE VIEW forestation AS
SELECT
    f.country_code,
    f.country_name,
    f.year,
    f.forest_area_sqkm,
    l.total_area_sq_mi,
    l.total_area_sq_mi * 2.59 AS total_area_sqkm,
    r.region,
    r.income_group,
    ROUND(
        (f.forest_area_sqkm / (l.total_area_sq_mi * 2.59) * 100)::NUMERIC,
        2
    ) AS percent_forest
FROM
    forest_area f
INNER JOIN
    land_area l
    ON f.country_code = l.country_code
    AND f.year = l.year
INNER JOIN
    regions r
    ON f.country_code = r.country_code;
```

2. GLOBAL SITUATION QUERY

```
WITH world_comparison AS (
    SELECT
        f1990.forest_area_sqkm AS forest_area_1990,
        f2016.forest_area_sqkm AS forest_area_2016,
        f2016.forest_area_sqkm - f1990.forest_area_sqkm AS forest_area_change,
        ROUND(
            ((f2016.forest_area_sqkm - f1990.forest_area_sqkm) / f1990.forest_area_sqkm * 100)::NUMERIC,
            2
        ) AS percent_change,
        ABS(f2016.forest_area_sqkm - f1990.forest_area_sqkm) AS area_lost
    FROM
        forestation f1990
    INNER JOIN
        forestation f2016
        ON f1990.country_code = f2016.country_code
    WHERE
        f1990.country_name = 'World'
        AND f1990.year = 1990
        AND f2016.year = 2016
),
closest_country AS (
    SELECT
        f.country_name,
        f.total_area_sqkm,
        wc.area_lost,
        ABS(f.total_area_sqkm - wc.area_lost) AS difference
    FROM
        forestation f,
        world_comparison wc
    WHERE
        f.year = 2016
        AND f.country_name != 'World'
        AND f.total_area_sqkm IS NOT NULL
    ORDER BY
        difference ASC
    LIMIT 1
)
SELECT
    wc.forest_area_1990,
    wc.forest_area_2016,
    wc.forest_area_change,
    wc.percent_change,
    cc.country_name AS closest_country,
    cc.total_area_sqkm AS closest_country_area
FROM
    world_comparison wc,
    closest_country cc;
```

3. REGIONAL OUTLOOK QUERY

```
WITH regional_forest AS (
    SELECT
        r1990.region,
        ROUND(
            (SUM(r1990.forest_area_sqkm) / SUM(r1990.total_area_sqkm) * 100)::NUMERIC,
            2
        ) AS forest_percent_1990,
        ROUND(
            (SUM(r2016.forest_area_sqkm) / SUM(r2016.total_area_sqkm) * 100)::NUMERIC,
            2
        ) AS forest_percent_2016
    FROM
        forestation r1990
    INNER JOIN
        forestation r2016
        ON r1990.country_code = r2016.country_code
    WHERE
        r1990.year = 1990
        AND r2016.year = 2016
        AND r1990.forest_area_sqkm IS NOT NULL
        AND r2016.forest_area_sqkm IS NOT NULL
        AND r1990.total_area_sqkm IS NOT NULL
        AND r2016.total_area_sqkm IS NOT NULL
    GROUP BY
        r1990.region
),
world_forest AS (
    SELECT
        'World' AS region,
        percent_forest AS forest_percent_1990,
        NULL::NUMERIC AS forest_percent_2016
    FROM
        forestation
    WHERE
        country_name = 'World'
        AND year = 1990
    UNION ALL
    SELECT
        'World' AS region,
        NULL::NUMERIC AS forest_percent_1990,
        percent_forest AS forest_percent_2016
    FROM
        forestation
    WHERE
        country_name = 'World'
        AND year = 2016
)
SELECT
    COALESCE(rf.region, wf.region) AS region,
    COALESCE(rf.forest_percent_1990, MAX(wf.forest_percent_1990)) AS forest_percent_1990,
    COALESCE(rf.forest_percent_2016, MAX(wf.forest_percent_2016)) AS forest_percent_2016,
    CASE
        WHEN rf.region IS NOT NULL
        THEN rf.forest_percent_2016 - rf.forest_percent_1990
        ELSE MAX(wf.forest_percent_2016) - MAX(wf.forest_percent_1990)
    END AS percent_change
FROM
    regional_forest rf
FULL OUTER JOIN
    world_forest wf
    ON rf.region = wf.region
GROUP BY
    rf.region, rf.forest_percent_1990, rf.forest_percent_2016, wf.region
ORDER BY
    CASE WHEN COALESCE(rf.region, wf.region) = 'World' THEN 0 ELSE 1 END,
    COALESCE(rf.region, wf.region);
```

4. COUNTRY-LEVEL DETAIL QUERY

```
WITH success_absolute AS (
    SELECT 'SUCCESS_ABSOLUTE' AS query_type, f1990.country_name, f1990.region,
           f2016.forest_area_sqkm - f1990.forest_area_sqkm AS change_value, NULL AS quartile
    FROM forestation f1990 INNER JOIN forestation f2016 ON f1990.country_code = f2016.country_code
    WHERE f1990.year = 1990 AND f2016.year = 2016 AND f1990.country_name != 'World'
          AND f1990.forest_area_sqkm IS NOT NULL AND f2016.forest_area_sqkm IS NOT NULL
          AND f2016.forest_area_sqkm > f1990.forest_area_sqkm
    ORDER BY change_value DESC LIMIT 2
),
concern_absolute AS (
    SELECT 'CONCERN_ABSOLUTE' AS query_type, f1990.country_name, f1990.region,
           f2016.forest_area_sqkm - f1990.forest_area_sqkm AS change_value, NULL AS quartile
    FROM forestation f1990 INNER JOIN forestation f2016 ON f1990.country_code = f2016.country_code
    WHERE f1990.year = 1990 AND f2016.year = 2016 AND f1990.country_name != 'World'
          AND f1990.forest_area_sqkm IS NOT NULL AND f2016.forest_area_sqkm IS NOT NULL
    ORDER BY change_value ASC LIMIT 5
),
quartile_counts AS (
    SELECT 'QUARTILE_COUNT' AS query_type, quartile AS country_name, NULL AS region,
           COUNT(*)::NUMERIC AS change_value, quartile
    FROM (
        SELECT CASE WHEN percent_forest <= 25 THEN '0-25%'
                    WHEN percent_forest > 25 AND percent_forest <= 50 THEN '25-50%'
                    WHEN percent_forest > 50 AND percent_forest <= 75 THEN '50-75%'
                    ELSE '75-100%' END AS quartile
        FROM forestation WHERE year = 2016 AND percent_forest IS NOT NULL AND country_name != 'World'
    ) sub GROUP BY quartile
)
SELECT * FROM success_absolute
UNION ALL SELECT * FROM concern_absolute
UNION ALL SELECT * FROM quartile_counts
ORDER BY query_type, change_value DESC;
```