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 41282694.9 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sqkm, a loss of 1324449 sqkm, 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 1279999.99 sqkm).

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%
Sub-Saharan Africa	30.67%	28.79%
World	32.42%	31.38%

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 (30.67% 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 527229.06 sqkm. 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 sqkm, 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	541510

Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234
Nigeria	Sub-Saharan Africa	106506
Tanzania	Sub-Saharan Africa	102320

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%
Fed. Sts. Micronesia	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%

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?*

From our analysis, we have found that the total global forest area has decreased by 3.21% (41,282,694.9 sqkm to 39,958,245.9 sqkm) between the year 1990 and 2016. Therefore, it is with great importance that we form initiatives, communications, and personnel allocation to

prevent any further increase to the deforestation rate of our planet. Although the percentage of forest area has decreased globally, there are certain regions and countries that we should focus on contributing significantly to that data. Between 1990 and 2016, we found that the only regions seeing a decrease in forest percentage were the Latin American & Caribbean and the Sub-Saharan African regions. The countries that contribute to the greatest decrease included in these regions are Brazil, Nigeria, and Tanzania. I would recommend that the country in Latin America & Caribbean that we should most focus raising awareness for is Brazil. We should also look to the Sub-Saharan African countries such as Nigeria, Togo, and Tanzania. These countries are showing the greatest decreases in forest area and percentages. I also recommend that we study the other regions and countries that have shown an increase in forest area and percentages. We should study their policies and initiatives that have increased the worlds forest area and maybe implement their strategies to the countries seeing decreases in forest area. Countries such as China and Iceland have shown an increase in forest area and percentage from 1990 to 2016, with China by 527,229.06 sqkm and Iceland increasing by 213.66%

5. APPENDIX: SQL Queries Used

```
/* DA102.3 Deforestation Project*/
/* Pre-Step: 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,
                r.region,
                r.income_group,
                f.forest_area_sqkm/(l.total_area_sq_mi * 2.59) AS percent_forest_area
          FROM forest_area AS f
            INNER JOIN land_area AS l
            ON f.country_code = l.country_code
            AND f.year = l.year
            INNER JOIN regions AS r
            ON r.country_code = f.country_code
);
-- Check to see if it works
SELECT *
  FROM forestation
 LIMIT 10;

/* Create a new column that provides the percent of the land area that is designated as forest */
```

```
f.forest_area_sqkm/(l.total_area_sq_mi * 2.59)

-- Create a DROP VIEW
DROP VIEW IF EXISTS forestation;

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

-- Step 1: Global Outlook
/*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
        forest_area_sqkm AS forest_area_sqkm_1990
  FROM forestation
 WHERE year = '1990' AND country_name = 'World';

/* 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
        forest_area_sqkm AS forest_area_sqkm_2016
  FROM forestation
 WHERE year = '2016' AND country_name = 'World';

/* What was the change (in sq km) in the forest area of the world from 1990 to 2016? */
WITH forest_area_1990
AS (
```

```
        SELECT
                forest_area_sqkm AS forest_area_sqkm_1990
          FROM forestation
         WHERE year = '1990' AND country_name = 'World'
        ),

forest_area_2016
AS (
        SELECT
                forest_area_sqkm AS forest_area_sqkm_2016
          FROM forestation
         WHERE year = '2016' AND country_name = 'World'
        )

SELECT
        (SELECT forest_area_sqkm_2016
           FROM forest_area_2016),
        (SELECT forest_area_sqkm_1990
           FROM forest_area_1990),
        (SELECT forest_area_sqkm_2016 FROM forest_area_2016 ) - (SELECT
forest_area_sqkm_1990 FROM forest_area_1990)
        AS difference

/* What was the percent change in forest area of the world between 1990 and 2016? */
-- Include WITH statement
SELECT
        (((SELECT forest_area_sqkm_2016 FROM forest_area_2016)-(SELECT
forest_area_sqkm_1990 FROM forest_area_1990))*100)/
        (SELECT forest_area_sqkm_1990 FROM forest_area_1990)
        AS percent_diff

/* 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? */
-- Include WITH statement
-- Abs value is 1324449
SELECT
        (SELECT forest_area_sqkm_2016
           FROM forest_area_2016),
        (SELECT forest_area_sqkm_1990
           FROM forest_area_1990),
        country_name,
        ABS((SELECT forest_area_sqkm_2016 FROM forest_area_2016 ) - (SELECT
forest_area_sqkm_1990 FROM forest_area_1990))
        AS abs_difference_forest_area_lost,
```

```
        (total_area_sq_mi * 2.59) AS total_area_sqkm
  FROM forestation
 WHERE year = '2016'
      AND (total_area_sq_mi * 2.59) BETWEEN 1250000 AND 1400000
 ORDER BY total_area_sqkm DESC;

-- Step 2: Regional Outlook
/* Create a table that shows the Regions and their percent forest area (sum of forest area
divided by sum of land area)
in 1990 and 2016. (Note that 1 sq mi = 2.59 sq km).*/
WITH forest_percentage_1990
AS (
        SELECT
                region AS rn1990,
                100*(SUM(forest_area_sqkm))/((SUM(total_area_sq_mi)*2.59)) AS fp1990
    FROM forestation
   WHERE year = '1990'
   GROUP BY region
   ORDER BY fp1990 DESC
),

forest_percentage_2016
AS (
        SELECT
                region AS rn2016,
                100*(SUM(forest_area_sqkm))/((SUM(total_area_sq_mi)*2.59)) AS fp2016
    FROM forestation
   WHERE year = '2016'
   GROUP BY region
   ORDER BY fp2016 DESC
),

joined_forest_percentage
AS (
        SELECT
                rn2016 AS region_name,
                fp1990.fp1990 AS fp_1990,
                fp2016.fp2016 AS fp_2016
        FROM forest_percentage_1990 AS fp1990
            INNER JOIN forest_percentage_2016 AS fp2016
            ON rn2016 = rn1990
        ORDER BY rn2016
         )
```

```
/*What was the percent forest of the entire world in 2016? */
-- Using the WITH statement
SELECT
	ROUND(fp2016::numeric,2)
FROM forest_percentage_2016
WHERE rn2016 = 'World'
/* Which region had the HIGHEST percent forest in 2016, and which had the LOWEST, to 2
decimal places? */
SELECT
	rn2016,
	ROUND(fp2016::numeric,2)
FROM forest_percentage_2016

/* What was the percent forest of the entire world in 1990? */
SELECT
	rn1990,
	ROUND(fp1990::numeric,2)
	FROM forest_percentage_1990
 WHERE rn1990 = 'World'
/* Which region had the HIGHEST percent forest in 1990, and which had the LOWEST, to 2
decimal places? */
SELECT
	rn1990,
	ROUND(fp1990::numeric,2)
	FROM forest_percentage_1990

/* Based on the table you created, which regions of the world DECREASED in forest area from
1990 to 2016? */
SELECT
	region_name,
	fp_1990,
	fp_2016,
	fp_1990 - fp_2016 AS percent_difference
  FROM joined_forest_percentage
 ORDER BY percent_difference DESC;


/* Success Story */
WITH fa1990
AS (
		SELECT
			country_name AS cn1990,
			country_code AS cc1990,
			region AS r1990,
```

```
                    forest_area_sqkm
                FROM forestation
                WHERE year = '1990'
                ORDER BY forest_area_sqkm DESC
                ),

fa2016
AS (
        SELECT
                    country_name AS cn2016,
                    country_code AS cc2016,
                    region AS r2016,
                    forest_area_sqkm
                FROM forestation
                WHERE year = '2016'
                ORDER BY forest_area_sqkm DESC
        ),

joined_fa
AS (
                SELECT
                    cn2016,
                    cc2016,
                    r2016,
                    fa2016.forest_area_sqkm AS fa2016,
                    fa1990.forest_area_sqkm AS fa1990
                    FROM fa2016
                        INNER JOIN fa1990
                        ON  cc2016 = cc1990
                )

SELECT
        cn2016,
        cc2016,
        r2016,
        fa2016,
        fa1990,
        fa2016 - fa1990 AS fadiff
  FROM joined_fa
 WHERE fa2016 - fa1990 IS NOT NULL
 ORDER BY fadiff DESC;

SELECT
        cn2016,
```

```
        cc2016,
        r2016,
        ((fa2016 - fa1990)/fa1990)*100 AS pdfa
  FROM joined_fa
 WHERE ((fa2016 - fa1990)/fa1990)*100 IS NOT NULL
 ORDER BY pdfa 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? */
-- Using the WITH Statements
SELECT
        cn2016,
        cc2016,
        r2016,
        fa2016,
        fa1990,
        fa2016 - fa1990 AS fadiff
  FROM joined_fa
 ORDER BY fadiff ASC;

/* 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? */
-- Using the WITH Statements
SELECT
        cn2016,
        cc2016,
        r2016,
        ((fa2016 - fa1990)/fa1990)*100 AS pdfa
  FROM joined_fa
 ORDER BY pdfa ASC;

/* If countries were grouped by percent forestation in quartiles, which group had the most
countries in it in 2016? */
SELECT
        CASE
                WHEN percent_forest_area <= 25
                THEN '0-25%'

                WHEN percent_forest_area > 25
                AND percent_forest_area <= 50
                THEN '25-50%'

                WHEN percent_forest_area > 50
                AND percent_forest_area <=75
```

```
                THEN '50-75%'
                ELSE '75-100%'
        END AS quartiles,
        COUNT(country_code) AS country_count
 FROM forestation
WHERE forest_area_sqkm IS NOT NULL
    AND total_area_sq_mi IS NOT NULL
    AND country_name != 'World'
    AND year = '2016'
GROUP BY quartiles
ORDER BY quartiles ASC

/* List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016. */
SELECT
        CASE
                WHEN percent_forest_area <= 25
                THEN '0-25%'

                WHEN percent_forest_area > 25
                AND percent_forest_area <= 50
                THEN '25-50%'

                WHEN percent_forest_area > 50
                AND percent_forest_area <=75
                THEN '50-75%'
                ELSE '75-100%'
        END AS quartiles,
        country_name,
   country_code,
   region,
   percent_forest_area
 FROM forestation
WHERE forest_area_sqkm IS NOT NULL
    AND total_area_sq_mi IS NOT NULL
    AND country_name != 'World'
    AND year = '2016'
GROUP BY quartiles, country_name, country_code, percent_forest_area, region
ORDER BY quartiles DESC , percent_forest_area DESC
LIMIT 9

/* How many countries had a percent forestation higher than the United States in 2016? */
WITH fp_usa_2016
AS (
                SELECT
```

```
                percent_forest_area
            FROM forestation
            WHERE country_name = 'United States'
                AND year = '2016'
            )

SELECT
    COUNT(country_code) AS country_count_greater
FROM forestation
WHERE forestation.percent_forest_area > (
                                                    SELECT
                                                    percent_forest_area
                                                FROM forestation
                                                WHERE country_name = 'United
States'
                                                    AND year = '2016'
                                                )
                                AND year = '2016'
```