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** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9**, a loss of **1324449**, 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 **27.55**. 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 **27.55**. 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**
Europe & Central Asia	**37.28**	**38.04**
North America	**35.65**	**36.04**
World	**32.42**	**31.38**
Sub-Saharan Africa	**30.67**	**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** (**30.67**% 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**. 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**, 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**	**282193.9844**
Myanmar	**East Asia & Pacific**	**107234.0039**
Nigeria	**Sub-Saharan Africa**	**106506.00098**
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%	**73**
50-75%	**38**
75-100%	**9**

The largest number of countries in 2016 were found in the **first (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**	**98.2576939676578**
Micronesia, Fed. Sts.	**East Asia & Pacific**	**91.8572390715248**
Gabon	**Sub-Saharan Africa**	**90.0376418700565**
Seychelles	**Sub-Saharan Africa**	**88.4111367385789**
Palau	**East Asia & Pacific**	**87.6068085491203**
American Samoa	**East Asia & Pacific**	**87.5000875000875**
Guyana	**Latin America & Caribbean**	**83.9014489110682**

Lao PDR	**East Asia & Pacific**	**82.1082317640861**
Solomon Islands	**East Asia & Pacific**	**77.8635177945066**

5. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.

- *What have you learned from the World Bank data?*
    - ***While some of the smaller countries, like Iceland, are having growth in forest area, the overall amount of area loss (both aggregate and percentage) due to larger countries with more landmass cancels out any growth. This has led to an overall decrease in the percentage of forest area throughout the world (as seen in Table 2.1: Percent Forest Area by Region, 1990 & 2016).***
- *Which countries should we focus on over others?*
    - ***As shown in Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016, we must continue to, and even increase, focus / efforts in the Sub-Saharan Africa region as they have 4 out of the 5 countries with the highest decrease in the percent of forest area change. With that being said, however, I believe that we must focus on all countries to further any/all effort to continue to increase forest land area: instead of evenly distributing our focus across the globe, we can split it up from which country(ies) need the least help (but still need help), to which country(ies) need to most help (as explained above).***

APPENDIX - SQL Code

```
--Create the forestation view--
CREATE VIEW forestation AS (
    SELECT
        fa.country_code,
        fa.country_name,
        fa.year,
        fa.forest_area_sqkm,
        la.total_area_sq_mi,
        r.region,
        r.income_group,
        100 * ((fa.forest_area_sqkm) / (la.total_area_sq_mi * 2.95)) AS
land_area_percentage_sqkm
    FROM forest_area fa, land_area la, regions r
    WHERE fa.country_code = la.country_code AND fa.year = la.year AND
la.country_code = r.country_code);

--Open forestation to view--
SELECT *
FROM forestation;

--GLOBAL SITUATION--

--Total forest area of the world in 1990--
SELECT
    country_name,
    year,
    forest_area_sqkm
FROM forestation
WHERE country_name = 'World' AND year = 1990
GROUP BY 1, 2, 3;

--Total forest area of the world in 2016--
SELECT
    country_name,
    year,
```

```
    forest_area_sqkm
FROM forestation
WHERE country_name = 'World' AND year = 2016
GROUP BY 1, 2, 3;

--Total loss of forest area from 1990 to 2016--
WITH past_area AS
    (SELECT forest_area_sqkm AS past_sqkm
     FROM forestation
     WHERE country_name = 'World' AND year = 1990
     GROUP BY 1),
current_area AS
    (SELECT forest_area_sqkm AS current_sqkm
     FROM forestation
     WHERE country_name = 'World' AND year = 2016
     GROUP BY 1)

SELECT (past_sqkm - current_sqkm) AS difference_in_area
FROM past_area, current_area;

--Percentage total loss of forest area from 1990 to 2016--
WITH past_area AS
    (SELECT forest_area_sqkm AS past_sqkm
     FROM forestation
     WHERE country_name = 'World' AND year = 1990
     GROUP BY 1),
current_area AS
    (SELECT forest_area_sqkm AS current_sqkm
     FROM forestation
     WHERE country_name = 'World' AND year = 2016
     GROUP BY 1)

SELECT (((past_sqkm - current_sqkm) / past_sqkm) * 100) AS
percent_difference
FROM past_area, current_area;

--Forest area lost slighty more than this country with total sqkm,--
```

```sql
--(instructors gave us Peru as answer, just need to find magnitude)--
WITH past_area AS
    (SELECT forest_area_sqkm AS past_sqkm
     FROM forestation
     WHERE country_name = 'World' AND year = 1990
     GROUP BY 1),
current_area AS
    (SELECT forest_area_sqkm AS current_sqkm
     FROM forestation
     WHERE country_name = 'World' AND year = 2016
     GROUP BY 1)

SELECT (past_sqkm - current_sqkm) AS area_loss,
    (total_area_sq_mi * 2.59) AS total_area,
    country_name
FROM past_area, current_area, forestation
WHERE year = 2016 AND country_name = 'Peru'
GROUP BY 1, 2, 3
ORDER BY total_area;

--REGIONAL OUTLOOK--

--2016 land area percentage--
SELECT AVG(land_area_percentage_sqkm) AS total_land_forest
FROM forestation
WHERE year = 2016 AND country_name = 'World';

--Region w/ highest & lowest relative forestation (w/ %) 2016--
SELECT region,
    ((SUM(forest_area_sqkm)*100) / SUM(total_area_sq_mi * 2.59)) AS
percent_region_forest
FROM forestation
WHERE year = 2016
GROUP BY 1
ORDER BY 2 DESC;

--1990 land area percentage--
```

```sql
SELECT AVG(land_area_percentage_sqkm) AS total_land_forest
FROM forestation
WHERE year = 1990 AND name = 'World';

--Region w/ highest & lowest relative forestation (w/ %) 1990--
SELECT region,
    ((SUM(forest_area_sqkm)*100) / SUM(total_area_sq_mi * 2.59)) AS
percent_region_forest
FROM forestation
WHERE year = 1990
GROUP BY 1
ORDER BY 2 DESC;

--Table 2.1--
WITH t_1990 AS
    (SELECT region,
            ROUND(CAST(perc_reg_f_1990 AS numeric), 2)
     FROM
        (SELECT region,
                ((SUM(forest_area_sqkm) * 100) / SUM(total_area_sq_mi *
2.59)) AS perc_reg_f_1990
        FROM forestation
        WHERE year = 1990
        GROUP BY 1
        ORDER BY 2) t1),

t_2016 AS
    (SELECT region,
            ROUND(CAST(perc_reg_f_2016 AS numeric), 2)
     FROM
        (SELECT region,
                ((SUM(forest_area_sqkm) * 100) / SUM(total_area_sq_mi *
2.59)) AS perc_reg_f_2016
        FROM forestation
        WHERE year = 2016
        GROUP BY 1
        ORDER BY 2) t2)
```

```sql
SELECT t_1990.region, t_1990.round AS region_percent_1990, t_2016.round AS
region_percent_2016
FROM t_1990
JOIN t_2016
    ON t_1990.region = t_2016.region
ORDER BY region_percent_2016 DESC;

--COUNTRY-LEVEL DETAIL--

--Success Stories--
--Largest Concerns--
--Table 3.1--
WITH t_1990 AS
    (SELECT country_name,
        year,
        SUM(forest_area_sqkm) AS total_forest_area
     FROM forestation
     WHERE year = 1990
     GROUP BY 1, 2
     ORDER BY 2),

t_2016 AS
    (SELECT country_name,
        year,
        SUM(forest_area_sqkm) AS total_forest_area
     FROM forestation
     WHERE year = 2016
     GROUP BY 1, 2
     ORDER BY 2)

SELECT t_1990.country_name,
       region,
      (t_1990.total_forest_area - t_2016.total_forest_area) AS
forest_area_difference
FROM t_1990
JOIN t_2016
```

```
    ON t_1990.country_name = t_2016.country_name
JOIN regions
    ON t_1990.country_name = regions.country_name
WHERE t_1990.country_name != 'World' AND (t_1990.total_forest_area -
t_2016.total_forest_area) IS NOT NULL
ORDER BY forest_area_difference DESC
LIMIT 5;

--Table 3.2--
WITH t_1990 AS
    (SELECT country_name,
            year,
            SUM(forest_area_sqkm) AS tfa
     FROM forestation
     WHERE year = 1990
     GROUP BY 1, 2
     ORDER BY 2),

t_2016 AS
    (SELECT country_name,
            year,
            SUM(forest_area_sqkm) AS tfa
     FROM forestation
     WHERE year = 2016
     GROUP BY 1, 2
     ORDER BY 2)

SELECT country_name,
       region,
       ROUND(CAST(forest_area_perc_change AS numeric), 2)
FROM
    (SELECT t_1990.country_name,
            region,
            (100 * ((t_1990.tfa - t_2016.tfa) / t_1990.tfa)) AS
forest_area_perc_change
    FROM t_1990
    JOIN t_2016
```

```
        ON t_1990.country_name = t_2016.country_name
    JOIN regions
        ON t_1990.country_name = regions.country_name
    WHERE (t_1990.tfa - t_2016.tfa) IS NOT NULL
    ORDER BY forest_area_perc_change DESC
    LIMIT 5) total_perc_change;

--Quartiles--
--Table 3.3--
WITH t_2016 AS
    (SELECT country_name,
            ((SUM(forest_area_sqkm)*100) / SUM(total_area_sq_mi * 2.59))
AS total_perc_forest,
            year
    FROM forestation
    WHERE year = 2016
    GROUP BY 1, 3
    ORDER BY 2)

SELECT DISTINCT(quartiles),
       COUNT(country_name) OVER (PARTITION BY quartiles)
FROM
    (SELECT country_name,
        CASE
            WHEN total_perc_forest >= 0 AND total_perc_forest < 25 THEN
'0-25%'
            WHEN total_perc_forest >= 25 AND total_perc_forest < 50 THEN
'25-50%'
            WHEN total_perc_forest >= 50 AND total_perc_forest < 75 THEN
'50-75%'
            ELSE '75-100%'
        END AS quartiles
        FROM t_2016
        WHERE year = 2016 AND total_perc_forest IS NOT NULL)
quartile_table
ORDER BY 1;
```

```sql
--Table 3.4--
WITH t_2016 AS
    (SELECT country_name,
            region,
            ((SUM(forest_area_sqkm)*100) / SUM(total_area_sq_mi * 2.59))
AS total_perc_forest,
            year
    FROM forestation
    WHERE year = 2016
    GROUP BY 1, 2, 4
    ORDER BY 3)

SELECT country_name,
       region,
       total_perc_forest
FROM t_2016
WHERE total_perc_forest >= 75
ORDER BY total_perc_forest DESC;

--Some code adapted from:--
--https://github.com/OSSYULYYZ/Udacity-SQL/blob/master/SQL-Deforestation/deforestation.sql--
```