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**, or **3.21** %.

The forest area lost over this time period is slightly more than the entire land area of **494208.49 SqKm** listed for the year 2016 (which is **Peru**).

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 **527229.062Sq 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 **79200 SqKm**, 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 **212.5%** 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: **Brazil, Indonesia and Myanmar**.

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 sq km**
Indonesia	**East Asia & Pacific**	**282193.9844 sq km**
Myanmar	**East Asia & Pacific**	**107234.0039 sq km**
Nigeria	**Sub-Saharan Africa**	**106506.00098 sq km**
Tanzania	**Sub-Saharan Africa**	**102320 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**	**75.45**
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 and 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	**84**
2	**73**
3	**38**
4	**9**

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

5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*

  Analysis on the data provided by the World Bank provides us an insight into how deforestation has progressed over the years and the urgent need for action to reduce deforestation and to increase forest area all over the world.

- *Which countries should we focus on over others?*

  Togo, Nigeria, Uganda, Mauritania and Honduras are some of the countries that might need more focus on than the others.

APPENDIX: SQL queries used

1. Create a **View** called **“forestation”** by joining all three tables - **forest_area, land_area** and **regions** in the workspace.
2. The **forest_area** and **land_area** tables *join* on both **country_code** AND **year**.
3. The **regions** table joins these based on only **country_code**.
4. In the ‘forestation’ View, include the following:
    - **All of the columns of the origin tables**
    - A **new column** that provides the **percent of the land area that is designated as forest**.
5. *Keep in mind* that the column **forest_area_sqkm** in the forest_area table and the **land_area_sqmi** in the land_area table are in **different units (square kilometers and square miles, respectively)**, so an adjustment will need to be made in the calculation you write (1 sq mi = 2.59 sq km).

```
DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation AS
(
 SELECT f.country_code f_country_code,
        f.country_name f_country_name,
        f.year f_year,
        f.forest_area_sqkm f_area_sqkm,
        --l.country_code l_country_code,
        --l.country_name l_country_name,
        --l.year l_year,
        l.total_area_sq_mi l_area_sq_mi,
        --r.country_name r_country_name,
        --r.country_code r_country_code,
        r.region region,
        r.income_group income_group,
    --calculate land area from sqmi into sqkm
        l.total_area_sq_mi*2.59 l_area_sqkm,
    --percent of land area that is designated as forest
```

```
   ROUND((f.forest_area_sqkm/(l.total_area_sq_mi*2.59)*100)::numeric,2) percent_f_area

  FROM forest_area f
  JOIN land_area l ON f.year= l.year AND f.country_code=l.country_code
  JOIN regions r  ON r.country_code= l.country_code);
```

1. GLOBAL SITUATION

a. 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 SUM(f_area_sqkm)
 FROM forestation
 WHERE region ='World' AND f_year = 1990;
```

b. 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 SUM(f_area_sqkm)
  FROM forestation
  WHERE region = 'World' AND f_year = 2016;
```

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
WITH F_90 AS
( SELECT f_country_code,SUM(f_area_sqkm) AS total_1990
 FROM forestation
 WHERE region = 'World' AND f_year =1990
 GROUP BY 1
),

f_16 AS
(
   SELECT f_country_code,SUM(f_area_sqkm) as total_2016
   FROM forestation
   WHERE region= 'World' AND f_year=2016
  GROUP BY 1
   )

 SELECT f_90.f_country_code,(f_90.total_1990-f_16.total_2016 ) AS difference
 FROM f_90
 JOIN f_16 ON f_90.f_country_code= f_16.f_country_code
```

```
 GROUP BY 1,2;
```

d. What was the percent change in forest area of the world between 1990 and 2016?

```
WITH F_90 AS
( SELECT f_country_code,SUM(f_area_sqkm) AS total_1990
 FROM forestation
 WHERE region = 'World' AND f_year =1990
 GROUP BY 1
),

f_16 AS
(
   SELECT f_country_code,SUM(f_area_sqkm) as total_2016
   FROM forestation
   WHERE region= 'World' AND f_year=2016
  GROUP BY 1
   )

 SELECT f_90.f_country_code,ROUND(((f_90.total_1990-f_16.total_2016
)/f_90.total_1990*100)::numeric,2) AS percent_difference
 FROM f_90
 JOIN f_16 ON f_90.f_country_code= f_16.f_country_code
 GROUP BY 1,2;
```

e. 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?

```
SELECT f_country_code, f_country_name, l_area_sq_mi
FROM forestation
WHERE l_area_sq_mi * 2.59 <
(SELECT
( SELECT forest_area_sqkm
                FROM forest_area
               WHERE country_name = 'World' AND year = 1990)-

              (SELECT forest_area_sqkm
              FROM forest_area
               WHERE country_name = 'World' AND year = 2016))
 AND f_year = '2016'
```

```
ORDER BY l_area_sq_mi DESC
LIMIT 1;
```

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).

```
DROP VIEW IF EXISTS region_percent;
CREATE VIEW region_percent AS
(SELECT region,f_year, ROUND((SUM(f_area_sqkm)/SUM(l_area_sqkm)*100)::numeric,2)
percent_region
 FROM forestation
WHERE f_year=1990 OR f_year=2016
 GROUP BY 1,2);
```

a. What was the percent forest of the entire world in 2016? Which region had the HIGHEST percent forest
in 2016, and which had the LOWEST, to 2 decimal places?

```
SELECT *
FROM region_percent
WHERE f_year=2016 AND region='World';
```

```
SELECT region, MAX(percent_region) highest
FROM region_percent
WHERE f_year =2016
GROUP BY 1
ORDER BY 2 DESC
LIMIT 1;
```

```
SELECT region, MIN(percent_region) lowest
FROM region_percent
WHERE f_year =2016
GROUP BY 1
ORDER BY 2 ASC
LIMIT 1;
```

b. What was the percent forest of the entire world in 1990? Which region had the HIGHEST percent forest
in 1990, and which had the LOWEST, to 2 decimal places?

```
SELECT *
FROM region_percent
WHERE f_year=1990 AND region='World';
```

```
SELECT region, MAX(percent_region) highest
FROM region_percent
WHERE f_year =1990
GROUP BY 1
ORDER BY 2 DESC
LIMIT 1;

SELECT region, MIN(percent_region) lowest
FROM region_percent
WHERE f_year =1990
GROUP BY 1
ORDER BY 2 ASC
LIMIT 1;
```

c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

```
With forest_percentage_1990 AS
(SELECT *
 FROM region_percent
WHERE f_year=1990),
forest_percentage_2016 AS
 (SELECT *
 FROM region_percent
WHERE f_year=2016)

SELECT forest_percentage_1990.region,
forest_percentage_1990.percent_region fa_90,
forest_percentage_2016.percent_region fa_16
FROM forest_percentage_1990
```

```
JOIN forest_percentage_2016 ON
forest_percentage_1990.region=forest_percentage_2016.region
WHERE forest_percentage_1990.percent_region > forest_percentage_2016.percent_region;
```

3. COUNTRY-LEVEL DETAIL

SUCCESS STORIES

```
WITH forest_1990 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region,percent_f_area,
 l_area_sqkm
 FROM forestation
 WHERE f_year=1990 ),

forest_2016 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region,percent_f_area,
 l_area_sqkm
 FROM forestation
 WHERE f_year=2016),

JOIN_90_16 AS
(SELECT forest_2016.f_country_name country_name,
       forest_1990.f_country_name,
       forest_2016.f_country_code,
       forest_1990.f_country_code,
       forest_2016.region f_region,
       forest_1990.region,
       forest_2016.l_area_sqkm la_16,
       forest_1990.l_area_sqkm  la_90,
       forest_1990.f_area_sqkm fa_90,
       forest_2016.f_area_sqkm fa_16,
       forest_1990.percent_f_area p_fa_90,
       forest_2016.percent_f_area p_fa_16
 FROM forest_1990
 JOIN forest_2016
 ON forest_1990.f_country_code=forest_2016.f_country_code)

 SELECT country_name,
       f_region,
       fa_90,
       fa_16,
```

```
        la_16,
        la_90,
        (fa_90-fa_16)  diff_area,
        ABS(((p_fa_90-p_fa_16)/p_fa_90)*100) percent_diff
  FROM JOIN_90_16
  WHERE fa_90 IS NOT NULL AND fa_16 IS NOT NULL AND country_name!='World' AND
p_fa_90 !=0
 ORDER BY 7

WITH forest_1990 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region,percent_f_area,
 l_area_sqkm
 FROM forestation
 WHERE f_year=1990 ),

forest_2016 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region,percent_f_area,
 l_area_sqkm
 FROM forestation
 WHERE f_year=2016),

JOIN_90_16 AS
(SELECT forest_2016.f_country_name country_name,
        forest_1990.f_country_name,
        forest_2016.f_country_code,
        forest_1990.f_country_code,
        forest_2016.region f_region,
        forest_1990.region,
        forest_2016.l_area_sqkm la_16,
        forest_1990.l_area_sqkm  la_90,
        forest_1990.f_area_sqkm fa_90,
        forest_2016.f_area_sqkm fa_16,
        forest_1990.percent_f_area p_fa_90,
        forest_2016.percent_f_area p_fa_16
 FROM forest_1990
 JOIN forest_2016
 ON forest_1990.f_country_code=forest_2016.f_country_code)

 SELECT country_name,
        f_region,
        fa_90,
        fa_16,
        la_16,
```

```
        la_90,
        (fa_16-fa_90)  diff_area,
        ABS(((p_fa_16-p_fa_90)/p_fa_90)*100) percent_diff
  FROM JOIN_90_16
  WHERE fa_90 IS NOT NULL AND fa_16 IS NOT NULL AND country_name!='World' AND
p_fa_90 !=0
 ORDER BY 8 DESC
```

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

```
WITH forest_1990 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region
 FROM forestation
 WHERE f_year=1990 AND f_area_sqkm IS NOT NULL AND f_country_name!='World'),

forest_2016 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region
 FROM forestation
 WHERE f_year=2016 AND f_area_sqkm IS NOT NULL AND f_country_name!='World')

SELECT forest_2016.f_country_name,
forest_2016.f_country_code,
forest_2016.region,
forest_1990.f_area_sqkm fa_90,
forest_2016.f_area_sqkm fa_16,
forest_1990.f_area_sqkm - forest_2016.f_area_sqkm    f_area_diff
FROM forest_1990
JOIN forest_2016 ON forest_1990.f_country_code=forest_2016.f_country_code
WHERE forest_1990.f_area_sqkm IS NOT NULL AND forest_2016.f_area_sqkm IS NOT NULL
ORDER BY 6 DESC
LIMIT 5;
```

b. 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?

```
WITH forest_1990 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region,percent_f_area
 FROM forestation
 WHERE f_year=1990 AND f_area_sqkm IS NOT NULL AND f_country_name!='World'),

forest_2016 AS
(SELECT f_country_code,f_country_name,f_year,f_area_sqkm,region,percent_f_area
 FROM forestation
 WHERE f_year=2016 AND f_area_sqkm IS NOT NULL AND f_country_name!='World')

SELECT forest_2016.f_country_name,
forest_2016.f_country_code,
forest_2016.region,
forest_2016.percent_f_area p_16,
forest_1990.percent_f_area p_90,
forest_1990.f_area_sqkm f_90,
forest_2016.f_area_sqkm f_16,
forest_1990.f_area_sqkm - forest_2016.f_area_sqkm f_area_diff,
ABS(ROUND(((forest_1990.f_area_sqkm-forest_2016.f_area_sqkm)/forest_1990.f_area_sqkm*
100)::numeric,2)) percent_diff
FROM forest_1990
JOIN forest_2016 ON forest_1990.f_country_code=forest_2016.f_country_code
WHERE forest_1990.f_area_sqkm IS NOT NULL AND
forest_2016.f_area_sqkm IS NOT NULL AND forest_2016.f_country_name!='World' AND
forest_1990.f_area_sqkm>forest_2016.f_area_sqkm
ORDER BY percent_diff DESC
LIMIT 5;
```

--c. If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
WITH t1 AS (
SELECT f_country_name, percent_f_area,region,
```

```
 CASE
 WHEN percent_f_area <=25 THEN 1
 WHEN percent_f_area >=25 AND percent_f_area <=50 THEN 2
 WHEN percent_f_area >=50 AND percent_f_area <=75 THEN 3
 ELSE 4
 END AS quartiles
 FROM forestation
 WHERE f_year=2016 AND percent_f_area!=0 and f_country_name IS NOT NULL
 GROUP BY 1,2,3
 ORDER BY 1)

 SELECT quartiles, count(f_country_name) countries
 FROM t1
GROUP BY 1
ORDER BY 2 DESC
```

d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

```
WITH t1 AS (
SELECT f_country_name, percent_f_area,region,
 CASE
 WHEN percent_f_area <=25 THEN 1
 WHEN percent_f_area >=25 AND percent_f_area <=50 THEN 2
 WHEN percent_f_area >=50 AND percent_f_area <=75 THEN 3
 ELSE 4
 END AS quartiles
 FROM forestation
 WHERE f_year=2016 AND percent_f_area!=0 and f_country_name IS NOT NULL
 GROUP BY 1,2,3
 ORDER BY 1)

SELECT f_country_name, quartiles, percent_f_area,region,count(*) as countries FROM T1
WHERE quartiles =4
GROUP BY 1,2,3,4
ORDER BY 3 DESC
```

e. How many countries had a percent forestation higher than the United States in 2016?

```
With t1 AS (SELECT f_country_code,
```

```
                f_country_name,
                f_year,
                f_area_sqkm,
                l_area_sqkm,
                percent_f_area
  FROM forestation
  WHERE f_country_name != 'World' AND
      f_area_sqkm IS NOT NULL AND
      l_area_sq_mi IS NOT NULL AND f_year=2016
                ORDER BY 6 DESC
            )
SELECT COUNT(t1.f_country_name)
    FROM t1
    WHERE t1.percent_f_area > (SELECT t1.percent_f_area
                            FROM t1
                            WHERE t1.f_country_name = 'United States')
```