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 1279999.9891sqkm 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%
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 (dropped from 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 79200.00sqkm, 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 sqkm
Indonesia	East Asia & Pacific	282193.98 sqkm
Myanmar	East Asia & Pacific	107234.00 sqkm
Nigeria	Sub-Saharan Africa	106506.00 sqkm
Tanzania	Sub-Saharan Africa	102320.00 sqkm

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% (1st quartile)	85
25%-50% (2nd quartile)	73
50%-75% (3rd quartile)	38
75%-100% (4th quartile)	9

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

There were 85 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

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?*

The data from the World Bank gives us lot of information about the deforestation around the world. The Global deforestation situation is concerning. When we have a look at region level, we see that more efforts need to be taken in Latin America & Caribbean and Sub-Saharan Africa regions compared to the other regions to reduce deforestation. Though these are only two regions out of seven regions in the world, the forest area drop of these regions is large which has affected the world forest percent. Different methods which can prevent deforestation should be implemented in these regions so that there is increase in forest areas.

On the other hand, if we look at country-level, we notice there are large countries like China, USA which have made tremendous improvements to combat deforestation by increasing forest area. Other countries can use the steps taken in China to improve their forest area. Different measures such as planting more trees, reserving more area for forests, using less paper from trees, recycling etc can surely help countries to increase their forest areas. The citizens of the countries should also be made aware of the importance of trees and strict rules should be in place for them to follow.

5. APPENDIX: SQL Queries Used

Steps to Complete

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_name                AS country_name,
         f.year                        AS YEAR,
         f.forest_area_sqkm            AS 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_area
  FROM   forest_area f
         FULL JOIN land_area l
           ON l.country_code = f.country_code
              AND l.year = f.year
         FULL 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 forest_area,
       year,
       country_name
FROM   forestation
WHERE  year = '1990'
       AND country_name = 'World'
```

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 forest_area,
       year,
       country_name
FROM   forestation
WHERE  year = '2016'
       AND country_name = 'World'
```

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

```
WITH tab_1990
     AS (SELECT forest_area_sqkm AS forest_area_1990,
```

```
                year,
                country_name
         FROM   forestation
         WHERE  year = '1990'
                AND country_name = 'World'),
     tab_2016
     AS (SELECT forest_area_sqkm AS forest_area_2016,
                year,
                country_name
         FROM   forestation
         WHERE  year = '2016'
                AND country_name = 'World')
SELECT ( tab_1990.forest_area_1990 - tab_2016.forest_area_2016 ) AS
       forest_area_change
FROM   tab_1990
       FULL JOIN tab_2016
              ON tab_2016.country_name = tab_1990.country_name
```

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

```
SELECT 100*(f1.forest_area_sqkm -
f2.forest_area_sqkm)/f2.forest_area_sqkm AS percentage
FROM forestation AS f1
JOIN forestation AS f2
     ON (f1.year='2016' AND f2.year='1990'
    AND f1.country_name='World' AND f2.country_name='World')
```

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 ( total_area_sq_mi * 2.59 )                AS total,
       Abs(1324449 - ( total_area_sq_mi * 2.59 )) AS difference,
       year,
       country_name
FROM   forestation
WHERE  year = '2016'
ORDER  BY difference
```

2. REGIONAL OUTLOOK

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 region,
       Round(( SUM(forest_area_sqkm) * 100 / SUM(total_area_sqkm) ) ::
 NUMERIC,
```

```
       2) AS
       percent_forest_change
FROM   forestation
WHERE  year = '2016'
GROUP  BY region
ORDER  BY percent_forest_change DESC
```

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 region,
       Round(( SUM(forest_area_sqkm) * 100 / SUM(total_area_sqkm) ) ::
 NUMERIC,
       2) AS
       percent_forest_change
FROM   forestation
WHERE  year = '1990'
GROUP  BY region
ORDER  BY percent_forest_change DESC
```

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

```
WITH tab_1990
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) * 100 / SUM(total_area_s
qkm) ) ::
                      NUMERIC,
                2) AS
                percent_forest_change_1990
         FROM   forestation
         WHERE  year = '1990'
         GROUP  BY region
         ORDER  BY percent_forest_change_1990 DESC),
     tab_2016
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) * 100 / SUM(total_area_s
qkm) ) ::
                      NUMERIC,
                2) AS
                percent_forest_change_2016
         FROM   forestation
         WHERE  year = '2016'
         GROUP  BY region
         ORDER  BY percent_forest_change_2016 DESC)
SELECT tab_1990.region,
```

```
       ( percent_forest_change_1990 - percent_forest_change_2016 ) AS
       percent_change_1990_2016
FROM   tab_1990
       inner join tab_2016
               ON tab_1990.region = tab_2016.region
```

3. COUNTRY-LEVEL DETAIL

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 tab_1990
     AS (SELECT region,
                country_name,
                forest_area_sqkm AS forest_area_sqkm_1990
         FROM   forestation
         WHERE  forest_area_sqkm IS NOT NULL
                AND year = '1990'
         GROUP  BY country_name,
                   region,
                   forest_area_sqkm_1990
         ORDER  BY forest_area_sqkm DESC),
     tab_2016
     AS (SELECT region,
                country_name,
                forest_area_sqkm AS forest_area_sqkm_2016
         FROM   forestation
         WHERE  forest_area_sqkm IS NOT NULL
                AND year = '2016'
         GROUP  BY country_name,
                   region,
                   forest_area_sqkm_2016
         ORDER  BY forest_area_sqkm DESC)
SELECT tab_1990.country_name,
       tab_1990.region,
       Round(( forest_area_sqkm_1990 - forest_area_sqkm_2016 ) :: NUME
RIC, 2) AS
       forest_area_change
FROM   tab_1990
       inner join tab_2016
               ON tab_1990.country_name = tab_2016.country_name
WHERE  tab_1990.country_name != 'World'
ORDER  BY forest_area_change
```

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 tab_1990 AS
(
         SELECT   country_name,
                  region,
                  forest_area_sqkm AS forest_area_sqkm_1990
         FROM     forestation
         WHERE    forest_area_sqkm IS NOT NULL
         AND      year='1990'
         GROUP BY country_name,
                  region,
                  forest_area_sqkm_1990
         ORDER BY forest_area_sqkm DESC ), tab_2016 AS
(
         SELECT   country_name,
                  region,
                  forest_area_sqkm AS forest_area_sqkm_2016
         FROM     forestation
         WHERE    forest_area_sqkm IS NOT NULL
         AND      year='2016'
         GROUP BY country_name,
                  region,
                  forest_area_sqkm_2016
         ORDER BY forest_area_sqkm DESC )
SELECT     tab_1990.country_name,
           tab_1990.region,
           Round(((forest_area_sqkm_1990 - forest_area_sqkm_2016)*100/
forest_area_sqkm_1990)::numeric,2) AS percent_forest_area_change
FROM       tab_1990
INNER JOIN tab_2016
ON         tab_1990.country_name=tab_2016.country_name
ORDER BY   percent_forest_area_change DESC limit 5
```

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

```
WITH tab1
     AS (SELECT country_name,
                forest_area_sqkm * 100 / total_area_sqkm AS forest_per
centage,
                CASE
                  WHEN forest_area_sqkm * 100 / total_area_sqkm >= 75
THEN
```

```
                  '75%-100%'
                  WHEN forest_area_sqkm * 100 / total_area_sqkm >= 50
THEN
                  '50%-75%'
                  WHEN forest_area_sqkm * 100 / total_area_sqkm >= 25
THEN
                  '25%-50%'
                  ELSE '0%-25%'
                END                                          AS quartiles
         FROM   forestation
         WHERE  year = '2016'
                AND forest_area_sqkm * 100 / total_area_sqkm IS NOT NU
LL
                AND country_name != 'World')
SELECT quartiles,
       Count(*)
FROM   tab1
GROUP  BY quartiles
ORDER  BY quartiles
```

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

```
WITH tab1
     AS (SELECT country_name,
                region,
                forest_area_sqkm * 100 / total_area_sqkm AS forest_per
centage,
                CASE
                  WHEN forest_area_sqkm * 100 / total_area_sqkm >= 75
THEN
                  '75%-100%'
                  WHEN forest_area_sqkm * 100 / total_area_sqkm >= 50
THEN
                  '50%-75%'
                  WHEN forest_area_sqkm * 100 / total_area_sqkm >= 25
THEN
                  '25%-50%'
                  ELSE '0%-25%'
                END                                          AS quartiles
         FROM   forestation
         WHERE  year = '2016'
                AND forest_area_sqkm * 100 / total_area_sqkm IS NOT NU
LL
                AND country_name != 'World')
SELECT country_name,
```

```
       region,
       Round(forest_percentage :: NUMERIC, 2) AS forest_percent
FROM   tab1
WHERE  forest_percentage >= 75
GROUP  BY quartiles,
          country_name,
          region,
          Round(forest_percentage :: NUMERIC, 2)
ORDER  BY quartiles DESC
```

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

```
WITH tab1
     AS (SELECT country_name,
                forest_area_sqkm * 100 / total_area_sqkm    AS forest_
percentage
                ,
                (SELECT forest_area_sqkm * 100 /
                        total_area_sqkm AS forest_percentage
                 FROM   forestation
                 WHERE  year = '2016'
                        AND forest_area_sqkm * 100 / total_area_sqkm I
S NOT NULL
                        AND country_name != 'World'
                        AND country_name = 'United States') AS us_fore
st_percent
         FROM   forestation
         WHERE  year = '2016'
                AND country_name != 'World')
SELECT country_name,
       Round(forest_percentage :: NUMERIC, 2) AS forest_percent
FROM   tab1
WHERE  forest_percentage > us_forest_percent
```