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 percentage 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 the Middle East & North Africa, with 2.07% forestation.

In 1990, the percentage of the total land area of the world designated as forest was 32.42%. The region with the highest relative forestation was still Latin America & Caribbean, with 51.02%, and the region with the lowest relative forestation was the 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 527,229.062. 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 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's forest area increased 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	-541,510 sq km
Indonesia	East Asia & Pacific	-282,193.98 sq km
Myanmar	East Asia & Pacific	-107,234 sq km
Nigeria	Sub Saharan Africa	-106,506 sq km
Tanzania	Sub Saharan Africa	-102,320 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	-61.8%
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
26-50%	38
51-75%	72
76-100%	9

The largest number of countries in 2016 were found in the Q1 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	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?*

The data shows us a series of very important features and alot can be gleaned from these sets. First off we know that the country that is of the largest concern is brazil. We can see that this country alone has lost half a million sq km since 1990. That is approximately the equivalent of losing the total land of Israel every year! But this may be partly because of the fact that such a large percent of its total land area is forest (65% in 1990).
So when we balance loss of forest by the total land area, it becomes very clear that as a region Sub Saharan Africa is the most affected region with Nigeria being in the worst shape. Seeing how this is not the most forest-rich region in the world, East Asia & Pacific is, then these numbers are alarming and need to be curbed before they are lost. According to this rate it will take less than 180 years before there are no forests left in Sub-Saharan Africa. (see links below). So this is the first region that needs to be addressed.
Some areas to possibly improve could be to implement policies that are effective in other areas in restricting the harmful practices that contribute to unrestrained forest loss. Some of these measures can be found below. A bright area is East Asia & Pacific. This region has the highest percent of forestation compared to total land area, yet it does not seem to be experiencing the same degradation as other regions like Latin America and Caribbean or SSAfrica. Perhaps some important lessons can be taken from their policies and measures in curbing deforestation.

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.
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
 (SELECT forest_area.country_code,
         forest_area.country_name,
         forest_area.year,
         Round(forest_area.forest_area_sqkm :: numeric, 2)          AS
            forest_area_sqkm,
         Round(( land_area.total_area_sq_mi * 2.59 ) :: numeric, 2) AS
```

```
           land_area_sqkm,
        regions.region,
        regions.income_group,
        Round(( forest_area.forest_area_sqkm / (
                land_area.total_area_sq_mi * 2.59 ) *
                100 )
              :: numeric, 2)                                    AS
           perc_of_forest_area
  FROM   forest_area
        JOIN land_area
          ON forest_area.country_code = land_area.country_code
             AND forest_area.year = land_area.year
        JOIN regions
          ON regions.country_code = forest_area.country_code)
```

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.

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).

part 1. global situation

Assignment

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.

41282694.9 sqkm

```
SELECT Sum(FA.forest_area_sqkm) AS TOT_FOR_AREA,
      FA.year,
      R.region
FROM   forest_area AS FA
      JOIN regions AS R
        ON R.country_code = FA.country_code
GROUP  BY 2,
         3
HAVING year = 1990
      AND region = 'World'
ORDER  BY 2
```

```
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.”
39958245.9 sqkm
SELECT Sum(FA.forest_area_sqkm) AS TOT_FOR_AREA,
      FA.year,
      R.region
FROM   forest_area AS FA
      JOIN regions AS R
        ON R.country_code = FA.country_code
GROUP  BY 2,
          3
HAVING year = 2016
      AND region = 'World'
ORDER  BY 2
c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?
1,324,449 sqkm
WITH area_1990
    AS (SELECT Sum(fa.forest_area_sqkm) AS tot_for_area,
               fa.year,
               r.region
        FROM   forest_area AS fa
               JOIN regions AS r
                 ON r.country_code = fa.country_code
        GROUP  BY 2,
                  3
        HAVING year = 1990
               AND region = 'World'
        ORDER  BY 2),
    area_2016
    AS (SELECT Sum(FA.forest_area_sqkm) AS TOT_FOR_AREA,
               FA.year,
               R.region
        FROM   forest_area AS FA
               JOIN regions AS R
                 ON R.country_code = FA.country_code
        GROUP  BY 2,
                  3
        HAVING year = 2016
               AND region = 'World'
```

```
        ORDER  BY 2)
SELECT Sum(area_1990.tot_for_area - area_2016.tot_for_area) diff
FROM   area_1990
      JOIN area_2016
        ON area_1990.region = area_2016.region
```

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

3.21%

```
WITH area_1990
    AS (SELECT Sum(FA.forest_area_sqkm) AS TOT_FOR_AREA,
               FA.year,
               R.region
        FROM   forest_area AS FA
               JOIN regions AS R
                 ON R.country_code = FA.country_code
        GROUP  BY 2,
                  3
        HAVING year = 1990
               AND region = 'World'
        ORDER  BY 2),
    area_2016
    AS (SELECT Sum(FA.forest_area_sqkm) AS TOT_FOR_AREA,
               FA.year,
               R.region
        FROM   forest_area AS FA
               JOIN regions AS R
                 ON R.country_code = FA.country_code
        GROUP  BY 2,
                  3
        HAVING year = 2016
               AND region = 'World'
        ORDER  BY 2),
    diff
    AS (SELECT Sum(area_1990.tot_for_area - area_2016.tot_for_area)AS DIFF_KM,
               area_1990.region
        FROM   area_1990
               JOIN area_2016
                 ON area_1990.region = area_2016.region
        GROUP  BY 2)
SELECT ( diff_km / area_1990.tot_for_area ) * 100 AS DIFF_PERC
```

```
FROM   diff,
       area_1990
```

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?

PERU

```
SELECT country_name,
       land_area_sqkm,
       year
FROM   forestation
WHERE  land_area_sqkm BETWEEN 1270000 AND 1350000
       AND year = 2016
ORDER  BY 2 DESC
```

part 2. regional outlook

Answering these questions will help you add information into the template.

Use these questions as guides to write SQL queries.

Use the output from the query to answer these questions.

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).

Based on the table you created, ...

```
SELECT DISTINCT region,
               Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS perc_forest
               ,
               year
FROM   forestation
WHERE  year = 2016
       OR year = 1990
GROUP  BY 1,
          3
ORDER  BY 1
```

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?

i) 31.38%

```
SELECT DISTINCT region,
               Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS perc_forest
               ,
               year
FROM   forestation
WHERE  year = 2016
       AND region = 'World'
```

```
GROUP  BY 1,
         3
ORDER  BY 1
ii) Latin America & Caribbean
SELECT DISTINCT region,
               Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS perc_forest
               ,
               year
FROM   forestation
WHERE  year = 2016
GROUP  BY 1,
         3
ORDER  BY 2 DESC
LIMIT  1

iii) Middle East & North Africa
SELECT DISTINCT region,
               Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS perc_forest
               ,
               year
FROM   forestation
WHERE  year = 2016
GROUP  BY 1,
         3
ORDER  BY 2
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?
32.42%
SELECT DISTINCT REGION, SUM(forest_area_sqkm)/SUM(land_area_sqkm)*100 AS perc_forest,
YEAR
FROM FORESTATION
WHERE YEAR = 1990 AND REGION = 'World'
GROUP BY 1,3
ORDER BY 1
ii) Latin America & Caribbean
SELECT DISTINCT region,
               Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS perc_forest
               ,
```

```
              year
FROM   forestation
WHERE  year = 1990
GROUP  BY 1,
          3
ORDER  BY 2 DESC
LIMIT  1
iii) Middle East & North Africa
SELECT DISTINCT region,
              Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS perc_forest
              ,
              year
FROM   forestation
WHERE  year = 1990
GROUP  BY 1,
          3
ORDER  BY 2
LIMIT  1
c. Based on the table you created, which regions of the world DECREASED in forest area
from 1990 to 2016?
Sub-Saharan Africa
World
Latin America & Caribbean
WITH area_1990
    AS (SELECT DISTINCT region,
                        Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS
                           perc_forest,
                        year
        FROM   forestation
        WHERE  year = 1990
        GROUP  BY 1,
                  3
        ORDER  BY 2),
    area_2016
    AS (SELECT DISTINCT region,
                        Sum(forest_area_sqkm) / Sum(land_area_sqkm) * 100 AS
                           perc_forest,
                        year
        FROM   forestation
```

```
        WHERE  year = 2016
        GROUP  BY 1,
                  3
        ORDER  BY 2)
SELECT DISTINCT area_2016.region,
               area_2016.perc_forest,
               area_2016.year
FROM   area_2016
      JOIN area_1990
        ON area_1990.region = area_2016.region
WHERE  area_2016.perc_forest < area_1990.perc_forest
ORDER  BY 2
```

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?

BRAZIL -541510

INDONESIA -282193.98

MYANMAR -107234

NIGERIA -106506

TANZANIA -102320

```
WITH area_1990 AS
(
      SELECT country_code,
             country_name,
             forest_area_sqkm
      FROM   forestation
      WHERE  year = 1990), area_2016 AS
(
      SELECT country_code,
             country_name,
             forest_area_sqkm
      FROM   forestation
      WHERE  year = 2016 )
SELECT   area_1990.country_name,
        area_2016.forest_area_sqkm-area_1990.forest_area_sqkm AS difference_amt
FROM     area_2016
INNER JOIN     area_1990
ON       area_2016.country_code=area_1990.country_code
WHERE    area_1990.country_name NOT LIKE 'World'
```

```
ORDER BY 2 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?

Togo -75.45

Nigeria - 61.8

Uganda -59.13

Mauritania -46.75

Honduras -45.03

```
WITH area_1990 AS
(
      SELECT country_name,
             forest_area_sqkm
      FROM   forestation
      WHERE  year = 1990), area_2016 AS
(
      SELECT country_name,
             forest_area_sqkm
      FROM   forestation
      WHERE  year = 2016)
SELECT   area_2016.country_name,

(area_2016.forest_area_sqkm-area_1990.forest_area_sqkm)*100/area_1990.forest_area_sqkm
AS difference_pct
FROM     area_2016
JOIN     area_1990
ON       area_2016.country_name=area_1990.country_name
ORDER BY 2 limit 5
```

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

Q1

```
WITH quartile_table
    AS (SELECT country_name,
               CASE
                 WHEN perc_of_forest_area >= 75 THEN 'Q4'
                 WHEN perc_of_forest_area >= 50 THEN 'Q3'
                 WHEN perc_of_forest_area >= 25 THEN 'Q2'
                 ELSE 'Q1'
               END AS quartile
        FROM   forestation
```

```
        WHERE  year = 2016
               AND perc_of_forest_area IS NOT NULL
               AND country_name NOT LIKE 'World'
        ORDER  BY 2 DESC)
SELECT quartile,
      Count(quartile)
FROM   quartile_table
GROUP  BY 1
```

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

```
SURINAME
MICRONESIA
GABON
SEYCHELLES
PALAU
AMERICAN SAMOA
GUYANA
LAO PDR
SOLOMON ISLANDS
```

```
WITH t1
    AS (SELECT country_name,
               region,
               perc_of_forest_area
        FROM   forestation
        WHERE  year = 2016)
SELECT *,
      CASE
        WHEN perc_of_forest_area > 76 THEN 'Q4'
        WHEN perc_of_forest_area > 51 THEN 'Q3'
        WHEN perc_of_forest_area > 26 THEN 'Q2'
        ELSE 'Q1'
      END AS quartile
FROM   t1
WHERE  perc_of_forest_area > 75
ORDER  BY 3 DESC
```

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

```
94
```

```
SELECT Count(country_name)
FROM   forestation
```

```
WHERE  year = 2016
     AND perc_of_forest_area > (SELECT perc_of_forest_area
                                FROM   forestation
                                WHERE  year = 2016
                                       AND country_name = 'United States')
```