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 km2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km2, a loss of 1324449 km^2, or 3.20%.

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 km2).

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 51.03%. The region with the highest relative forestation was Latin America & Caribbean, with 98.91%, and the region with the lowest relative forestation was Middle East & North Africa, with 1.78%.

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
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
South Asia	16.51	17.51

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 km2. 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 km2, 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
Indonesia	East Asia & Pacific	282193
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	-75.44
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 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 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
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?*

What I learned is that the deforestation is far from being uniform among countries in the world. Depending how we look at our data, locally or globally, one may draw different conclusions. Globally, the planet experiences the deforestation. I would not expect Chine and

US to be successful stories of increase of forest areas as these countries are known for being "profit" oriented. Thus, I would expect to find European countries as leaders in these rankings.

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

We should definitely focus more on countries with strong deforestation tendencies such as Brazil or Nigeria, because their deforestation affects the most global deforestation. It can lead to unpredictable effects on our planet Earth.

5. Appendix: SQL queries used

```
DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation AS
SELECT
  f.country_code code,
  f.country_name country,
  f.year "year",
  f.forest_area_sqkm forest_area_sqkm,
  l.total_area_sq_mi total_area_sq_mi,
  r.region region,
  r.income_group income_group,
  100.0*(f.forest_area_sqkm /
  (l.total_area_sq_mi * 2.59)) AS perc_forest_per_land
FROM forest_area f
JOIN land_area l ON (f.country_code = l.country_code
AND f.year = l.year)
INNER JOIN regions r ON (f.country_code = r.country_code);
```


```
SELECT * FROM forestation
```


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_sqkm FROM forest_area f
WHERE f.country_name = 'World' AND f.year = 1990
```
41282694.9 sqkm

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_sqkm FROM forest_area f
WHERE f.country_name = 'World' AND f.year = 2016
```
39958245.9 km2

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

```
WITH forest_1990 AS
(
  SELECT forest_area_sqkm
  FROM forest_area f
  WHERE f.country_name = 'World' AND f.year = 1990
),forest_2016 AS
(
  SELECT forest_area_sqkm
  FROM forest_area f
  WHERE f.country_name = 'World' AND f.year = 2016
)

SELECT (SELECT COALESCE(forest_area_sqkm, 0) FROM forest_1990) - (SELECT
COALESCE(forest_area_sqkm, 0) FROM forest_2016) AS difference_in_km
```

d. What was the percent change in forest area of the world between 1990 and 2016?
difference_in_km
```
WITH forest_1990 AS
(
  SELECT forest_area_sqkm
  FROM forest_area f
  WHERE f.country_name = 'World' AND f.year = 1990
),forest_2016 AS
(
  SELECT forest_area_sqkm
  FROM forest_area f
  WHERE f.country_name = 'World' AND f.year = 2016
)

SELECT 100*((SELECT COALESCE(forest_area_sqkm, 0) FROM forest_1990) - (SELECT
COALESCE(forest_area_sqkm, 0) FROM forest_2016))/(SELECT
COALESCE(forest_area_sqkm, 0) FROM forest_1990) AS difference_in_perc
```

3.2 %
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 country, (total_area_sq_mi * 2.59) AS total_area_sqkm
FROM forestation
WHERE year = 2016
ORDER BY total_area_sqkm DESC;
```

Peru   1279999.9891

Regional Outlook
Instructions:

    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
        region,
        perc_for_land,
      f.*
    FROM forestation f
    WHERE year = 2016 OR year = 1990
    ```

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(perc_for_land::numeric, 2) percentage
FROM forestation f
WHERE year = 2016 and country = 'World'

SELECT
        region,
        ROUND(perc_for_land::numeric, 2) percentage
FROM forestation f
WHERE year = 2016
ORDER BY 2 DESC
```
31.38% </br>
Latin America & Caribbean   98.26 </br>
Europe & Central Asia   0.00

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(perc_for_land::numeric, 2) percentage
FROM forestation f
WHERE year = 1990
ORDER BY 2 DESC
```

World   32.42% </br>
Latin America & Caribbean   98.91% </br>
Europe & Central Asia   0.00% </br>
c. Based on the table you created, which regions of the world DECREASED in forest area from
1990 to 2016?
```
WITH region_percent AS
(
  SELECT
        f1990.region,
        SUM(f1990.forest_area_sqkm) region_forest_1990,
    SUM(f1990.total_area_sq_mi * 2.59) region_area_1990,
    SUM(f2016.forest_area_sqkm) region_forest_2016,
    SUM(f2016.total_area_sq_mi * 2.59)  region_area_2016
  FROM  forestation f1990, forestation f2016
  WHERE  f1990.year = '1990'
  AND f2016.year = '2016'
  AND f1990.region = f2016.region
  GROUP  BY f1990.region
), forest_perc_90_16 AS
(
  SELECT
    region,
    ROUND(CAST((region_forest_1990/ region_area_1990) * 100 AS NUMERIC), 2)
   AS forest_percent_1990,
    ROUND(CAST((region_forest_2016 / region_area_2016) * 100 AS NUMERIC), 2)
    AS forest_percent_2016
  FROM region_percent
  ORDER  BY forest_percent_1990 DESC
)

SELECT fp.*,
fp.forest_percent_1990 - fp.forest_percent_2016 diff
FROM forest_perc_90_16 fp
ORDER BY 4 DESC

```

region forest_percent_1990 forest_percent_2016 diff </br>
Latin America & Caribbean   51.03   46.16   4.87 </br>
```

Sub-Saharan Africa    30.67   28.79   1.88 </br>
World   32.42   31.38   1.04 </br>
Middle East & North Africa     1.78     2.07     -0.29 </br>

## Country-Level Detail
Instructions:

   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.

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?

```
SELECT
        f1990.country_name,
   f1990.forest_area_sqkm forest_area_1990,
   f2016.forest_area_sqkm forest_area_2016,
   f1990.forest_area_sqkm - f2016.forest_area_sqkm diff
FROM forest_area f1990
JOIN forest_area f2016
ON f1990.year = 1990 AND f2016.year = 2016
AND f1990.country_name = f2016.country_name
ORDER BY 4
```


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?
```
SELECT
        f1990.country,
   f1990.region,
   f1990.forest_area_sqkm forest_area_1990,
   f2016.forest_area_sqkm forest_area_2016,
   f1990.forest_area_sqkm - f2016.forest_area_sqkm diff
FROM forestation f1990
JOIN forestation f2016
ON f1990.year = 1990 AND f2016.year = 2016
AND f1990.country = f2016.country
WHERE f1990.forest_area_sqkm IS NOT NULL
AND f2016.forest_area_sqkm  IS NOT NULL
ORDER BY 5 DESC
```

```
SELECT
        f1990.country,
    f1990.region,
    f1990.forest_area_sqkm forest_area_1990,
    f2016.forest_area_sqkm forest_area_2016,
    100*(f1990.forest_area_sqkm - f2016.forest_area_sqkm)/f1990.forest_area_sqkm AS
diff_perc
FROM forestation f1990
JOIN forestation f2016
ON f1990.year = 1990 AND f2016.year = 2016
AND f1990.country = f2016.country
WHERE f1990.forest_area_sqkm IS NOT NULL
AND f2016.forest_area_sqkm  IS NOT NULL
ORDER BY 5 DESC
```

c. If countries were grouped by percent forestation in quartiles, which group had the most
countries in it in 2016?
```
WITH countries_cat AS
(
  SELECT COUNTRY,
      perc_forest_per_land,
      CASE WHEN perc_forest_per_land <= 25 THEN '0%-25%'
    WHEN perc_forest_per_land <= 75 AND perc_forest_per_land > 50 THEN '50%-75%'
    WHEN perc_forest_per_land <= 50 AND perc_forest_per_land > 25 THEN '25%-50%'
    ELSE '75%-100%' END AS quartiles
  FROM forestation
  WHERE perc_forest_per_land IS NOT NULL AND year = 2016
)

SELECT distinct(quartiles),
        COUNT(country)
FROM countries_cat
GROUP BY quartiles
ORDER BY 1
```

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

```
```

```
WITH countries_cat AS
(
  SELECT country,
             region,
    perc_forest_per_land,
     CASE WHEN perc_forest_per_land <= 25 THEN '0%-25%'
   WHEN perc_forest_per_land <= 50 AND perc_forest_per_land > 25 THEN '25%-50%'
   WHEN perc_forest_per_land <= 75 AND perc_forest_per_land > 50 THEN '50%-75%'
   ELSE '75%-100%' END AS quartiles
  FROM forestation
  WHERE perc_forest_per_land IS NOT NULL AND year = 2016
)

SELECT country,
             region,
    perc_forest_per_land
FROM countries_cat
WHERE perc_forest_per_land > 75
ORDER BY 3 DESC
```

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

WITH countries_cat AS
(
  SELECT country,
             region,
    perc_forest_per_land,
     CASE WHEN perc_forest_per_land <= 25 THEN '0%-25%'
   WHEN perc_forest_per_land <= 50 AND perc_forest_per_land > 25 THEN '25%-50%'
   WHEN perc_forest_per_land <= 75 AND perc_forest_per_land > 50 THEN '50%-75%'
   ELSE '75%-100%' END AS quartiles
  FROM forestation
  WHERE perc_forest_per_land IS NOT NULL AND year = 2016
)

SELECT COUNT(*)
FROM countries_cat
WHERE perc_forest_per_land > (SELECT perc_forest_per_land FROM countries_cat WHERE
country = 'United States')

```