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 km^2** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 km^2** loss of **1324449 km^2, or 3.2082%.**

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 **1279999.9891 km^2**).

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

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 km^2 .** 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 km^2** much lower than the figure for **China.**

United States and **China** 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%** 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	Abs Forest Change
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282193.98
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	% Forest 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 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
1	84
2	73
3	38
4	9

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

There were **84** 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**	**Percent_forestation**
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	87.5
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?*

  From this data, it is clear that deforestation has greatly altered landscapes around the world. We see that many regions in the world have been decreasing in forest area. The data shows comparison between two years 2016 vs 1990. The total forest area of the world was 41282694.9 km^2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km^2 that is to say a loss of 1324449 km^2, or 3.2082%. To give an estimate, the total forest area lost is slightly greater than the entire land area of Peru. This is definitely very alarming and concerning.

  Let us understand why ?

  Throughout history and into modern times, forests have been razed to make space for agriculture and animal grazing, and to obtain wood for fuel, manufacturing, and construction. Building or upgrading roads into forests makes them more accessible for exploitation. Slash-and-burn agriculture is a big contributor to deforestation in the tropics. Deforestation can result in more carbon dioxide being released into the atmosphere. That is because trees take in carbon dioxide from the air for photosynthesis, and carbon is locked chemically in their wood. When trees are burned, this carbon returns to the atmosphere as carbon dioxide. With fewer trees around to take in the carbon dioxide, this greenhouse gas accumulates in the atmosphere and accelerates global warming.

  Deforestation also threatens the world's biodiversity. Tropical forests are home to great numbers of animal and plant species. When forests are logged or burned, it can drive many of those species into extinction. Some scientists say we are already in the midst of a mass-extinction episode. More immediately, the loss of trees from a forest can leave soil more prone to erosion. This causes the remaining plants to become more vulnerable to fire as the forest shifts from being a closed, moist environment to an open, dry one.

  While deforestation can be permanent, this is not always the case. In few countries and regions forests in many areas are returning thanks to conservation efforts.
  As seen from our data, few countries and regions of the world have been able to sustain and also increase their forest area coverage. China has actually increased in forest area from 1990 to 2016 by 527229.06 km^2 . The country with the next largest increase in forest area from 1990 to 2016 was the United States. We also have a smaller country Iceland increased in forest area by 213% from 1990 to 2016.

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

  The world has decreased in forest area from 1990 to 2016 and shows how much forest Latin America and the Caribbean, and Sub-Saharan Africa have lost.
  Almost all the countries whose forest coverage area has decreased falls in the Sub-Saharan Africa. Therefore, these countries Togo, Nigeria, Uganda, and Mauritania in Sub – Saharan Africa and Honduras, which is in the Latin America & Caribbean region. should prioritize and focus on preserving their forests. Learn the best practices followed in the countries such as China, United states and Iceland by partnering with them.

  Also it seen that 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.

Learn more about deforestation from the following pages –
https://education.nationalgeographic.org/resource/deforestation
https://www.embibe.com/exams/deforestation/

5. APPENDIX (SQL queries)

Tip : Format all SQL queries using https://sqlformat.org/ for readability

1. GLOBAL SITUATION

Create forestation view

```
CREATE OR REPLACE 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,
    fa.forest_area_sqkm/(la.total_area_sq_mi*2.59)*100 AS forest_percentage
FROM forest_area fa
JOIN land_area la ON fa.country_code = la.country_code
AND fa.year = la.year
```

JOIN regions r ON fa.country_code = r.country_code ;

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 forestation
WHERE country_name = 'World'
  AND 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 forest_area_sqkm
 FROM forestation
 WHERE country_name = 'World'
    AND YEAR = '2016’
```

Combining the two queries in a and b one -

```
SELECT country_name, year, forest_area_sqkm
FROM forestation
WHERE country_name='World' AND (YEAR='1990' OR YEAR='2016')
ORDER BY year ASC;
```

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

```
SELECT (f2016.forest_area_sqkm - f1990.forest_area_sqkm) AS change_sq_km
FROM forestation AS f1990, forestation AS f2016
WHERE f2016.year = '2016' AND f2016.country_name = 'World'
   AND   f1990.year = '1990' AND f1990.country_name = 'World';
```

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

```
SELECT ((f1990.forest_area_sqkm -
f2016.forest_area_sqkm)/f1990.forest_area_sqkm ) * 100 AS change_sq_km
FROM forestation AS f1990, forestation AS f2016
WHERE f1990.year = '1990' AND f1990.country_name = 'World'
   AND   f2016.year = '2016' AND f2016.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 country_name, total_area_sq_mi*2.59 AS total_area_sq_km
FROM forestation
WHERE year='2016' AND (total_area_sq_mi*2.59) < 1324449
ORDER BY 2 DESC
LIMIT 1;
```

2. REGIONAL OUTLOOK

Create the region_forest_area View

```
CREATE OR REPLACE VIEW region_forest_area AS WITH forest_area_2016 AS
  (SELECT region,
        SUM(fa.forest_area_sqkm) AS total_forest_area_sqkm_2016,
        SUM(la.total_area_sq_mi * 2.59) AS total_area_sqkm_2016,
        SUM(fa.forest_area_sqkm) * 100 / SUM(la.total_area_sq_mi * 2.59) AS
percent_fa_region_2016
   FROM forest_area fa
   JOIN land_area la ON fa.country_code = la.country_code
   AND fa.year = la.year
   JOIN regions r ON la.country_code = r.country_code
   WHERE fa.year = 2016
   GROUP BY 1
   ORDER BY 1),
                                    forest_area_1990 AS
  (SELECT region,
        SUM(fa.forest_area_sqkm) AS total_forest_area_sqkm_1990,
        SUM(la.total_area_sq_mi * 2.59) AS total_area_sqkm_1990,
        SUM(fa.forest_area_sqkm) * 100 / SUM(la.total_area_sq_mi * 2.59) AS
percent_fa_region_1990
```

```
  FROM forest_area fa
  JOIN land_area la ON fa.country_code = la.country_code
  AND fa.year = la.year
  JOIN regions r ON la.country_code = r.country_code
  WHERE fa.year = 1990
  GROUP BY 1
  ORDER BY 1)
SELECT fa2016.region,
    total_forest_area_sqkm_2016,
    total_area_sqkm_2016,
    percent_fa_region_2016,
    total_forest_area_sqkm_1990,
    total_area_sqkm_1990,
    percent_fa_region_1990
FROM forest_area_2016 fa2016
JOIN forest_area_1990 fa1990 ON fa1990.region = fa2016.region;
```

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 ROUND(percent_fa_region_2016::numeric, 2)
    FROM region_forest_area
    WHERE region = 'World';

SELECT region,
  ROUND(percent_fa_region_2016::numeric, 2) AS percent_fa_region
  FROM region_forest_area
  WHERE region != 'World'
    ORDER BY 2 DESC
    LIMIT 1;

 SELECT region,
  ROUND(percent_fa_region_2016::numeric, 2) AS percent_fa_region
  FROM region_forest_area
  WHERE region != 'World'
    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 ROUND(percent_fa_region_1990::numeric, 2)
      FROM region_forest_area
  WHERE region = 'World';

SELECT region,
   ROUND(percent_fa_region_1990::numeric, 2) AS percent_fa_region
   FROM region_forest_area
   WHERE region != 'World'
     ORDER BY 2 DESC
     LIMIT 1;

  SELECT region,
   ROUND(percent_fa_region_1990::numeric, 2) AS percent_fa_region
   FROM region_forest_area
   WHERE region != 'World'
     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?

```
SELECT
   region,
   ROUND(percent_fa_region_1990::numeric, 2) AS percent_fa_region_1990
   ROUND(percent_fa_region_2016::numeric, 2) AS percent_fa_region_2016
   FROM region_forest_area
     ORDER BY 2 DESC ;
```

3. COUNTRY-LEVEL DETAIL

Create the country_forest_area view

```
CREATE OR REPLACE VIEW country_forest_area AS WITH forest_area_2016 AS
  (SELECT fa.country_name,
        region,
        SUM(fa.forest_area_sqkm) AS total_forest_area_sqkm_2016,
        SUM(la.total_area_sq_mi * 2.59) AS total_area_sqkm_2016,
```

```
        SUM(fa.forest_area_sqkm) * 100 / SUM(la.total_area_sq_mi * 2.59) AS
percent_fa_region_2016
  FROM forest_area fa
  JOIN land_area la ON fa.country_code = la.country_code
  AND fa.year = la.year
  JOIN regions r ON la.country_code = r.country_code
  WHERE fa.year = 2016
    AND fa.forest_area_sqkm IS NOT NULL
  GROUP BY 1,
           2
  ORDER BY 1),
                                      forest_area_1990 AS
 (SELECT fa.country_name,
         region,
         SUM(fa.forest_area_sqkm) AS total_forest_area_sqkm_1990,
         SUM(la.total_area_sq_mi * 2.59) AS total_area_sqkm_1990,
         SUM(fa.forest_area_sqkm) * 100 / SUM(la.total_area_sq_mi * 2.59) AS
percent_fa_region_1990
  FROM forest_area fa
  JOIN land_area la ON fa.country_code = la.country_code
  AND fa.year = la.year
  JOIN regions r ON la.country_code = r.country_code
  WHERE fa.year = 1990
    AND fa.forest_area_sqkm IS NOT NULL
  GROUP BY 1,
           2
  ORDER BY 1)
SELECT fa2016.country_name "country",
       fa2016.region,
       total_forest_area_sqkm_2016,
       total_area_sqkm_2016,
       percent_fa_region_2016,
       total_forest_area_sqkm_1990,
       total_area_sqkm_1990,
       percent_fa_region_1990
FROM forest_area_2016 fa2016
JOIN forest_area_1990 fa1990 ON fa1990.country_name = fa2016.country_name;
```

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
country,
region,
ROUND((total_forest_area_sqkm_1990 - total_forest_area_sqkm_2016)::Numeric,2) AS
"Abs Forest Change"
FROM country_forest_area
WHERE country != 'World'
ORDER BY 3 ASC
LIMIT 5;
```

```
SELECT
country,
region,
ROUND((total_forest_area_sqkm_1990 - total_forest_area_sqkm_2016)::Numeric,2) AS
"Abs Forest Change"
FROM country_forest_area
WHERE country != 'World'
ORDER BY 3 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?

```
SELECT
country,
region,
ROUND(((total_forest_area_sqkm_1990 -
total_forest_area_sqkm_2016)/total_forest_area_sqkm_1990 * 100)::Numeric,2) AS "%
Forest Change"
FROM country_forest_area
WHERE country != 'World'
ORDER BY 3 DESC
LIMIT 5;
```

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

```
WITH C1 AS
  (SELECT country,
          percent_fa_region_2016
   FROM country_forest_area
   GROUP BY 1,
            2)
SELECT Distinct(quartiles),
       count(country)Over(PARTITION BY quartiles),
                  percent_fa_region_2016
FROM
  (SELECT country,
          CASE
             WHEN percent_fa_region_2016<25 THEN '1st quartile , 0-25'
             WHEN percent_fa_region_2016>=25
                AND percent_fa_region_2016<50 THEN '2nd quartile, 25-50'
             WHEN percent_fa_region_2016>=50
                AND percent_fa_region_2016<75 THEN '3rd quartile, 50-75'
             ELSE '4th quartile, 75-100'
          END AS quartiles
   FROM C1
   WHERE percent_fa_region_2016 IS NOT NULL ) q
```

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

```
 WITH C2 AS
  (WITH C1 AS
     (SELECT country,
             region,
             percent_fa_region_2016
      FROM country_forest_area
      GROUP BY 1,
               2,
               3) SELECT Distinct(quartiles),
                         count(country)Over(PARTITION BY quartiles),
                                   country,
                                   region,
                                   percent_fa_region_2016
   FROM
     (SELECT country,
             region,
```

```
            percent_fa_region_2016,
            CASE
               WHEN percent_fa_region_2016 <=25 THEN '0-25'
               WHEN percent_fa_region_2016 >25
                   AND percent_fa_region_2016 <=50 THEN '25-50'
               WHEN percent_fa_region_2016 >50
                   AND percent_fa_region_2016 <=75 THEN '50-75'
               ELSE '75-100'
            END AS quartiles
         FROM C1
         WHERE percent_fa_region_2016 IS NOT NULL ) sub)
SELECT country,
       region,
       quartiles,
       Round(percent_fa_region_2016::Numeric, 2) percent_forestation
FROM C2
WHERE quartiles = '75-100'
ORDER BY percent_fa_region_2016 DESC
```