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 **41286294.9 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 **1324449sqkm**, 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 **1279999.9891sqkm**).

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 and Caribbean**, with **41.16 %**, 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 and 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 Percent	2016 Forest Percent
Latin America & Caribbean	51.03	46.16
Sub-Saharan Africa	30.67	28.79
Europe & Central Asia	37.28	38.04
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.51
Middle East & North Africa	1.78	2.07
World	32.42	31.38
North America	35.65	36.04

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America and 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 **527229.06sqkm** . 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	DECREASE SQKM
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	PERCENT DECREASE
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:

Quartiles	No. of Countries
FIRST	85
SECOND	73
THIRD	38
FOURTH	9

The largest number of countries in 2016 were found in the **First** 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	PC 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	87.5
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

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

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5. RECOMMENDATIONS

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

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

  It can be deduced from the data that the situation in Sub-Saharan Africa is alarming. Particularly Nigeria is the country which needs to take measures to minimize the reduction of deforestation. However, in terms of area Brazil has the most area which has been affected since 1990. On the contrary, as evident from Table 3.4, some small countries have made immense progress in curbing the environmental damage. Overall, if we look at the world statistics, there has been difference in terms of percentage deforestation is approximately 1%.

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

Particularly, in Sub-Saharan African countries like Nigeria and Tanzania requires immediate attention. In addition to these, Brazil is one of those countries which has been affected most in terms of area.

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    AS CountryCode ,
         F.country_name    AS CountryName,
         F.year            AS YEAR,
         F.forest_area_sqkm,
         (L.total_area_sq_mi * 2.59) AS TotalArea_sqkm,
         R.region,
         R.income_group ,
         (F.forest_area_sqkm*100) / (2.59*L.total_area_sq_mi) AS fores
t_percent
  FROM   forest_area F
  JOIN   land_area L
  ON     F.country_code = L.country_code
  AND    F.year = L.year
  JOIN   regions R
  ON     R.country_code = F.country_code
  AND    R.country_code = L.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 year,
       forest_area_sqkm,
       region
```

```
FROM   forestation
WHERE  region = '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 year,
       forest_area_sqkm,
       region
FROM   forestation
WHERE  region = 'World'
       AND year = '2016'
```

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

```
WITH t1
     AS (SELECT forest_area_sqkm AS fa1990
         FROM   forestation
         WHERE  region = 'World'
                AND year = '1990'),
     t2
     AS (SELECT forest_area_sqkm AS fa2016
         FROM   forestation
         WHERE  region = 'World'
                AND year = '2016')
SELECT t1.fa1990 - t2.fa2016
      AS
       Drop_sqkm,
       Round(( ( t1.fa1990 - t2.fa2016 ) * 100 / t1.fa1990 ) :: NUMERI
C, 2) AS
       Percent_Drop_sqkm
FROM   t1,
       t2
```

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

```
WITH t1
     AS (SELECT forest_area_sqkm AS fa1990
         FROM   forestation
         WHERE  region = 'World'
                AND year = '1990'),
     t2
     AS (SELECT forest_area_sqkm AS fa2016
         FROM   forestation
         WHERE  region = 'World'
                AND year = '2016')
SELECT t1.fa1990 - t2.fa2016
      AS
```

```
       Drop_sqkm,
       Round(( ( t1.fa1990 - t2.fa2016 ) * 100 / t1.fa1990 ) :: NUMERI
C, 2) AS
       Percent_Drop_sqkm
FROM   t1,
       t2
```

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?

```
WITH t1
AS
  (
         SELECT forest_area_sqkm AS fa1990
         FROM   forestation
         WHERE  region = 'World'
         AND    year = '1990') ,
  t2
AS
  (
         SELECT forest_area_sqkm AS fa2016
         FROM   forestation
         WHERE  region = 'World'
         AND    year = '2016')
  SELECT   t1.fa1990 - t2.fa2016 AS drop_sqkm ,
           forestation.countryname ,
           forestation.totalarea_sqkm
  FROM     t1,
           t2 ,
           forestation
  WHERE    (
                   t1.fa1990 - t2.fa2016) > forestation.totalarea_sqk
m
  AND      year ='2016'
  ORDER BY 3 DESC
  LIMIT    1
```

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?

```
WITH forest_1990
AS
  (
            SELECT   region,
                     round((sum(forest_area_sqkm)*100/sum(totalarea_sqk
m) ):: NUMERIC ,2) AS forest_percent_1990
            FROM     forestation
            WHERE    year = '1990'
            GROUP BY 1) ,
  forest_2016
AS
  (
            SELECT   region,
                     round((sum(forest_area_sqkm)*100/sum(totalarea_sqk
m) ):: NUMERIC,2) AS forest_percent_2016
            FROM     forestation
            WHERE    year = '2016'
            GROUP BY 1)
  --SELECT *
  --FROM Forest_2016
  --WHERE region = 'World'
  --SELECT *
  --FROM Forest_2016
  --ORDER BY Forest_Percent_2016  DESC
  --LIMIT 1
  SELECT   *
  FROM     forest_2016
  ORDER BY forest_percent_2016 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?

```
WITH forest_1990
AS
  (
            SELECT   region,
                     round((sum(forest_area_sqkm)*100/sum(totalarea_sqk
m) ):: NUMERIC ,2) AS forest_percent_1990
            FROM     forestation
            WHERE    year = '1990'
            GROUP BY 1) ,
  forest_2016
AS
  (
            SELECT   region,
                     round((sum(forest_area_sqkm)*100/sum(totalarea_sqk
m) ):: NUMERIC,2) AS forest_percent_2016
            FROM     forestation
```

```
          WHERE    year = '2016'
          GROUP BY 1)
  --SELECT *
  --FROM Forest_1990
  --WHERE region = 'World'
  --SELECT *
  --FROM Forest_1990
  --ORDER BY Forest_Percent_1990  DESC
  --LIMIT 1
  SELECT   *
  FROM     forest_1990
  ORDER BY forest_percent_1990 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_1990
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) * 100 / SUM(totalarea_sq
km) ) ::
                      NUMERIC,
                2) AS
                Forest_Percent_1990
         FROM   forestation
         WHERE  year = '1990'
         GROUP  BY 1),
     forest_2016
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) * 100 / SUM(totalarea_sq
km) ) ::
                      NUMERIC,
                2) AS
                Forest_Percent_2016
         FROM   forestation
         WHERE  year = '2016'
         GROUP  BY 1)
SELECT forest_2016.region,
       forest_2016.forest_percent_2016,
       forest_1990.forest_percent_1990
FROM   forest_1990
       join forest_2016
         ON forest_2016.region = forest_1990.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 forest1990 AS
(
       SELECT countryname,
              region,
              forest_area_sqkm
       FROM   forestation
       WHERE  year='1990') , forest2016 AS
(
       SELECT countryname,
              region,
              forest_area_sqkm
       FROM   forestation
       WHERE  year='2016')
SELECT   forest1990.countryname,
         forest1990.region,
         Round(Abs(forest1990.forest_area_sqkm - forest2016.forest_are
a_sqkm )::numeric, 2)AS decrease_sqkm
FROM     forest1990
JOIN     forest2016
ON       forest1990.countryname = forest2016.countryname
WHERE    forest1990.forest_area_sqkm - forest2016.forest_area_sqkm IS
NOT NULL
AND      forest1990.region !='World'
ORDER BY forest1990.forest_area_sqkm - forest2016.forest_area_sqkm DES
C 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 forest1990 AS
(
       SELECT countryname,
              region,
              forest_area_sqkm
       FROM   forestation
       WHERE  year='1990') , forest2016 AS
(
       SELECT countryname,
              region,
              forest_area_sqkm
       FROM   forestation
       WHERE  year='2016')
SELECT   forest1990.countryname,
         forest1990.region,
         Round(Abs((forest1990.forest_area_sqkm - forest2016.forest_ar
ea_sqkm)*100/(forest1990.forest_area_sqkm))::numeric, 2)AS percentdec_
sqkm
FROM     forest1990
JOIN     forest2016
ON       forest1990.countryname = forest2016.countryname
WHERE    forest1990.forest_area_sqkm - forest2016.forest_area_sqkm IS
```

```
NOT NULL
AND      forest1990.region !='World'
ORDER BY (forest1990.forest_area_sqkm - forest2016.forest_area_sqkm)*1
00/(forest1990.forest_area_sqkm) DESC limit 5
```

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

```
WITH ranges
     AS (SELECT countrycode,
                forest_percent,
                CASE
                  WHEN forest_percent < 25 THEN 'FIRST'
                  WHEN forest_percent < 50 THEN 'SECOND'
                  WHEN forest_percent < 75 THEN 'THIRD'
                  WHEN forest_percent < 100 THEN 'FOURTH'
                END AS Quartiles
         FROM   forestation
         WHERE  year = '2016'
                AND forest_percent IS NOT NULL)
SELECT Count(ranges.countrycode),
       quartiles
FROM   ranges
GROUP  BY quartiles
ORDER  BY count DESC
```

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

```
WITH ranges
     AS (SELECT countryname,
                region,
                forest_percent,
                CASE
                  WHEN forest_percent < 25 THEN 'FIRST'
                  WHEN forest_percent < 50 THEN 'SECOND'
                  WHEN forest_percent < 75 THEN 'THIRD'
                  WHEN forest_percent < 100 THEN 'FOURTH'
                END AS Quartiles
         FROM   forestation
         WHERE  year = '2016'
                AND forest_percent IS NOT NULL)
SELECT ranges.countryname,
       ranges.region,
       Round(ranges.forest_percent :: NUMERIC, 2) AS PC_FOREST
FROM   ranges
WHERE  ranges.quartiles = 'FOURTH'
ORDER  BY pc_forest DESC
```

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

```
WITH t1
     AS (SELECT forest_percent AS US
         FROM   forestation
         WHERE  year = '2016'
                AND forest_percent IS NOT NULL
                AND countryname = 'United States')
SELECT Count(forestation.countryname) AS CountriesMoreThanUS
FROM   forestation,
       t1
WHERE  year = '2016'
       AND forest_percent IS NOT NULL
       AND forestation.forest_percent > t1.us
```