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 **41,282,694.90 km^2** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.90 km^2**, a loss of **1,324,449.00 km^2**, or **3.23%**.

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 km^2**).

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 **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 **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	Difference between 1990 and 2016 Forest Percentage
Latin America & Caribbean	51.03	46.16	-4.87
Sub-Saharan Africa	30.67	28.79	-1.88
World	32.42	31.38	-1.04
Europe & Central Asia	37.28	38.04	0.76
East Asia & Pacific	25.78	26.36	0.58
North America	35.65	36.04	0.39
South Asia	16.51	17.51	1
Middle East & North Africa	1.78	2.07	0.29

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 its 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 **79200.00 km^2**, 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** 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(km^2)
Brazil	Latin America & Caribbean	541510.00
Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234.00
Nigeria	Sub-Saharan Africa	106506.00
Tanzania	Sub-Saharan Africa	102320.00

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	-59.27
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
1	85
2	72
3	38
4	9

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

There were **9** countries in the top quartile(4th) 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?*

The World Bank data provides valuable insights into global forestation trends from 1990 to 2016. During this period, the world witnessed a significant decrease in forest area, losing 1,324,449.00 km^2, equivalent to 3.23% of the total forest cover. This loss exceeds the land area of Peru in 2016, illustrating the severity of the problem. Latin America & Caribbean emerged as an area of concern, having experienced the highest forest area loss, amounting to 541,510.00 km^2.

Analysis of the data reveals that the Sub-Saharan Africa region is particularly affected, with the top four countries experiencing the highest percentage decrease in forest area. In total, approximately 85 countries, accounting for almost 40% of all nations, have less than or equal to 25% of the total forest area, indicating widespread challenges.

However, amidst these concerning trends, there are promising signs of progress. Countries such as China, Iceland, and the United States have demonstrated an increase in forest area from 1990 to 2016. Notably, China stands out as a success story, having significantly expanded its forest area by 527,229.06 km^2. Even smaller countries like Iceland have experienced remarkable growth rates, with a 213.66% increase in forest area during the same period.

Nevertheless, the global deforestation trend remains a pressing issue, raising concerns about environmental impact and biodiversity loss. Urgent efforts are required to combat deforestation and promote sustainable forest management practices. The successes witnessed in countries like China underscore the potential for positive change, underscoring the importance of implementing effective policies and fostering international cooperation.

In conclusion, the World Bank data sheds light on the alarming decrease in global forest area between 1990 and 2016. Latin America & Caribbean and the Sub-Saharan Africa region have suffered substantial losses, while some countries have demonstrated encouraging trends in forest area expansion. However, the overall picture emphasizes the urgency of addressing

deforestation, preserving biodiversity, and implementing sustainable forest management practices. Raising awareness, enacting impactful policies, and fostering international collaboration are essential for protecting and restoring the world's forests for future generations.

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

Based on the available information and analysis, the countries that should be prioritized for focused attention in forest conservation efforts include Brazil, Indonesia, Myanmar, Nigeria and Tanzania. These countries have experienced significant forest area loss and require immediate intervention to address the underlying causes and implement sustainable forest management practices.

Nigeria stands out as a primary focus due to its position among the top five countries with the highest forest area and percentage loss. The severity of deforestation in Nigeria necessitates urgent action to mitigate further degradation and promote conservation.

Brazil, Indonesia, Myanmar, and Tanzania have also suffered substantial forest area loss and should be targeted for conservation efforts. Agricultural expansion, logging, and other factors contribute to deforestation in these countries, making it crucial to implement effective measures to combat forest degradation.

Additionally, the Sub-Saharan Africa region as a whole demands increased attention due to the highest percentage decrease in forest area. Many countries within this region, including Nigeria, Democratic Republic of Congo, and Tanzania, have encountered significant losses. Addressing deforestation drivers and promoting sustainable forest management practices are critical in these nations.

While prioritizing countries with high forest area loss, it is important to acknowledge the success stories and positive trends observed in countries like China, Iceland, and the United States. These countries can serve as models for others and provide valuable insights into successful forest conservation strategies.

In conclusion, focusing on Nigeria, Brazil, Indonesia, Myanmar, and Tanzania, as well as the broader Sub-Saharan Africa region, will help address deforestation and promote sustainable forest management. By prioritizing these countries, we can make significant strides in mitigating forest loss, preserving biodiversity, and ensuring a more sustainable future for our forests.

5. APPENDIX: SQL Queries Used

Create a View called “forestation” by joining all three tables - forest_area, land_area and regions in the workspace.

The forest_area and land_area tables join on both country_code AND year.

The regions table joins these based on only country_code.

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).

```
CREATE VIEW forestation
AS
  SELECT t1.country_name,
         t1.year,
         t3.region,
         t3.income_group,
         t1.forest_area_sqkm,
         t2.total_area_sq_mi,
         t2.total_area_sq_mi * 2.59
           AS total_area_sqkm,
( SUM(t1.forest_area_sqkm) / ( SUM(t2.total_area_sq_mi) * 2.59 ) ) * 100
   AS
forest_area_pct
  FROM   forest_area t1
         JOIN land_area t2
           ON t1.country_code = t2.country_code
              AND t1.year = t2.year
         JOIN regions t3
           ON t3.country_code = t1.country_code
  GROUP  BY t1.country_name,
            t1.year,
            t3.region,
            t3.income_group,
            t1.forest_area_sqkm,
            t2.total_area_sq_mi,
            t2.total_area_sq_mi * 2.59;
```

Part 1 - Global Situation

1a: 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,
    country_name
FROM   forestation
WHERE  year = '1990'
    AND country_name = 'World' ;
```

1b : 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,
    country_name
FROM   forestation
WHERE  year = '2016'
    AND country_name = 'World' ;
```

1c :What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
SELECT ABS(SUM(CASE
            WHEN year = '2016' THEN forest_area_sqkm
           END) - SUM(CASE
                       WHEN year = '1990' THEN forest_area_sqkm
                      END)) AS area_change
FROM   forestation
WHERE  country_name = 'World';
```

1d: What was the percent change in forest area of the world between 1990 and 2016?

```
SELECT ABS((( (SELECT SUM(forest_area_pct)
           FROM   forestation
           WHERE  year = '2016'
                AND country_name = 'World') - (SELECT SUM(forest_area_pct)
                                               FROM   forestation
                                               WHERE  year = '1990'
                                                    AND country_name =
                                                       'World')
              )) / (SELECT SUM(forest_area_pct)
                 FROM   forestation
```

```
                WHERE  year = '1990'
                    AND country_name = 'World')) * 100 AS
    pctchange_in_forest_area;
```

1e: 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_sqkm,
    ABS(total_area_sqkm - ABS((SELECT SUM(forest_area_sqkm)
                    FROM   forestation
                    WHERE  year = '2016'
                        AND country_name = 'World') -
                      (SELECT SUM(forest_area_sqkm)
                       FROM   forestation
                       WHERE  year = '1990'
                           AND country_name = 'World'))) AS
    diff
FROM   forestation
WHERE  year = 2016
ORDER  BY diff ASC
LIMIT  1;
```

Part 2 - Regional Outlook

2:

```
WITH forest_pct_1990 AS (
  SELECT region,
    CAST((SUM(forest_area_sqkm) / (SUM(total_area_sq_mi) * 2.59)) * 100 AS NUMERIC(10,
2)) AS pct_1990
  FROM forestation
  WHERE year = '1990'
  GROUP BY region
),
forest_pct_2016 AS (
  SELECT region,
    CAST((SUM(forest_area_sqkm) / (SUM(total_area_sq_mi) * 2.59)) * 100 AS NUMERIC(10,
2)) AS pct_2016
  FROM forestation
  WHERE year = '2016'
  GROUP BY region
)
```

```
SELECT t1.region,
      t1.pct_1990,
      t2.pct_2016,
      CAST(( t2.pct_2016-t1.pct_1990) AS NUMERIC(10, 2)) AS pct_change
FROM forest_pct_1990 t1
JOIN forest_pct_2016 t2 ON t1.region = t2.region;
```

2a:

SUB QUESTION: What was the percent forest of the entire world in 2016?

```
WITH forest_pct_1990
    AS (SELECT region,
            ( SUM(forest_area_sqkm) / ( SUM(total_area_sq_mi) * 2.59 ) ) *
            100 AS
              pct_1990
        FROM   forestation
        WHERE  year = '1990'
        GROUP  BY region),
    forest_pct_2016
    AS (SELECT region,
            ( SUM(forest_area_sqkm) / ( SUM(total_area_sq_mi) * 2.59 ) ) *
            100 AS
              pct_2016
        FROM   forestation
        WHERE  year = '2016'
        GROUP  BY region)
SELECT t1.region,
      ROUND(t2.pct_2016 :: NUMERIC, 2)
FROM   forest_pct_1990 t1
      JOIN forest_pct_2016 t2
        ON t1.region = t2.region
WHERE  t1.region = 'World'
```

SUB QUESTION: Which region had the HIGHEST percent forest in 2016, 2 DECIMAL

```
WITH forest_pct_1990 AS
(
        SELECT   region,
                (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_1990
        FROM     forestation
        WHERE    year = '1990'
```

```
        GROUP BY region), forest_pct_2016 AS
(
        SELECT   region,
                (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_2016
        FROM     forestation
        WHERE    year = '2016'
        GROUP BY region)
SELECT   t1.region ,
        ROUND(t2.pct_2016::numeric, 2) AS pct_2016
FROM     forest_pct_1990 t1
JOIN     forest_pct_2016 t2
ON       t1.region = t2.region
ORDER BY pct_2016 DESC LIMIT 1;
```

SUB QUESTION: which had the LOWEST percent forest in 2016, to 2 decimal places?

```
WITH forest_pct_1990 AS
(
        SELECT   region,
                (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_1990
        FROM     forestation
        WHERE    year = '1990'
        GROUP BY region), forest_pct_2016 AS
(
        SELECT   region,
                (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_2016
        FROM     forestation
        WHERE    year = '2016'
        GROUP BY region)
SELECT   t1.region ,
        ROUND(t2.pct_2016::numeric, 2) AS pct_2016
FROM     forest_pct_1990 t1
JOIN     forest_pct_2016 t2
ON       t1.region = t2.region
ORDER BY pct_2016 LIMIT 1;
```

2b:

SUB QUESTION: What was the percent forest of the entire world in 1990?

```
WITH forest_pct_1990
    AS (SELECT region,
```

```
            ( SUM(forest_area_sqkm) / ( SUM(total_area_sq_mi) * 2.59 ) ) *
            100 AS
              pct_1990
       FROM   forestation
       WHERE  year = '1990'
       GROUP  BY region),
    forest_pct_2016
    AS (SELECT region,
            ( SUM(forest_area_sqkm) / ( SUM(total_area_sq_mi) * 2.59 ) ) *
            100 AS
              pct_2016
       FROM   forestation
       WHERE  year = '2016'
       GROUP  BY region)
SELECT t1.region,
     ROUND(t1.pct_1990 :: NUMERIC, 2) AS pct_1990
FROM   forest_pct_1990 t1
     JOIN forest_pct_2016 t2
       ON t1.region = t2.region
WHERE  t1.region = 'World'
ORDER  BY t1.pct_1990 DESC;
```

SUB QUESTION: Which region had the HIGHEST percent forest in 1990

```
WITH forest_pct_1990 AS
(
       SELECT   region,
              (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_1990
       FROM     forestation
       WHERE    year = '1990'
       GROUP BY region), forest_pct_2016 AS
(
       SELECT   region,
              (SUM(forest_area_sqkm) /(Sum(total_area_sq_mi)*2.59))*100 AS pct_2016
       FROM     forestation
       WHERE    year = '2016'
       GROUP BY region)
SELECT   t1.region ,
       ROUND(t1.pct_1990::numeric, 2) AS pct_1990
FROM     forest_pct_1990 t1
JOIN     forest_pct_2016 t2
ON       t1.region = t2.region
WHERE    t1.region != 'World'
```

```
ORDER BY t1.pct_1990 DESC LIMIT 1;
```

SUB QUESTION: which had the LOWEST percent forest in 1990, to 2 decimal places?

```
WITH forest_pct_1990 AS
(
      SELECT   region,
            (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_1990
      FROM     forestation
      WHERE    year = '1990'
      GROUP BY region), forest_pct_2016 AS
(
      SELECT   region,
            (SUM(forest_area_sqkm) /(SUM(total_area_sq_mi)*2.59))*100 AS pct_2016
      FROM     forestation
      WHERE    year = '2016'
      GROUP BY region)
SELECT   t1.region ,
      ROUND(t1.pct_1990::numeric, 2) AS pct_1990
FROM     forest_pct_1990 t1
JOIN     forest_pct_2016 t2
ON       t1.region = t2.region
WHERE    t1.region != 'World'
ORDER BY t1.pct_1990 LIMIT 1;
```

2c: Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

```
WITH forest_pct_1990
   AS (SELECT region,
           ( SUM(forest_area_sqkm) / ( SUM(total_area_sq_mi) * 2.59 ) ) *
           100 AS
             pct_1990
      FROM   forestation
      WHERE  year = '1990'
      GROUP  BY region),
   forest_pct_2016
   AS (SELECT region,
           ( SUM(forest_area_sqkm) / ( SUM(total_area_sq_mi) * 2.59 ) ) *
           100 AS
             pct_2016
      FROM   forestation
```

```
        WHERE  year = '2016'
        GROUP  BY region)
SELECT t1.region,
       t1.pct_1990,
       t2.pct_2016
FROM   forest_pct_1990 t1
       JOIN forest_pct_2016 t2
         ON t1.region = t2.region
WHERE  pct_1990 > pct_2016
```

Part 3 - Country-Level Detail

3a: 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 forest_change_1990 AS
(
        SELECT   country_name,
                 region,
                 SUM(forest_area_sqkm) AS change_1990
        FROM     forestation
        WHERE    year = '1990'
        GROUP BY region,
                 country_name), forest_change_2016 AS
(
        SELECT   country_name,
                 SUM(forest_area_sqkm) AS change_2016
        FROM     forestation
        WHERE    year = '2016'
        GROUP BY country_name)
SELECT   t1.country_name,
        t1.region,
        t1.change_1990,
        t2.change_2016 ,
        ROUND(t1.change_1990::numeric, 2)-ROUND(t2.change_2016::numeric, 2) AS
change_forest_area
FROM     forest_change_1990 t1
JOIN     forest_change_2016 t2
ON       t1.country_name = t2.country_name
WHERE    ROUND(t2.change_2016::numeric, 2)-ROUND(t1.change_1990::numeric, 2) IS NOT
NULL
AND      t1.country_name != 'World'
```

```
ORDER BY change_forest_area DESC LIMIT 5;
```

3b: 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 forest_pct_1990 AS
(
      SELECT region,
            country_name,
            forest_area_sqkm
      FROM   forestation
      WHERE  year = '1990'
      AND    forest_area_sqkm IS NOT NULL
      AND    country_name != 'World' ), forest_pct_2016 AS
(
      SELECT country_name,
            forest_area_sqkm
      FROM   forestation
      WHERE  year = '2016'
      AND    forest_area_sqkm IS NOT NULL
      AND    country_name != 'World' )
SELECT   t1.country_name,
        region,
        ROUND(CAST(((t2.forest_area_sqkm - t1.forest_area_sqkm) / t1.forest_area_sqkm * 100)
AS NUMERIC),2) AS change_pct
FROM     forest_pct_1990 t1
JOIN     forest_pct_2016 t2
ON       t1.country_name = t2.country_name
AND      (
               t1.forest_area_sqkm IS NOT NULL
        AND      t2.forest_area_sqkm IS NOT NULL)
ORDER BY ROUND(CAST(((t2.forest_area_sqkm - t1.forest_area_sqkm) / t1.forest_area_sqkm
* 100) AS NUMERIC),2) LIMIT 5
```

3c: If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
 WITH quartile_group
    AS (SELECT country_name,
```

```
            forest_area_pct,
            CASE
              WHEN forest_area_pct >= 75 THEN '4'
              WHEN forest_area_pct >= 50 THEN '3'
              WHEN forest_area_pct >= 25 THEN '2'
              ELSE '1'
            END AS quartile
        FROM   forestation
        WHERE  year = 2016
            AND country_name != 'World'
            AND forest_area_pct IS NOT NULL)
SELECT quartile,
    COUNT(quartile) AS countries
FROM   quartile_group
GROUP  BY quartile
ORDER  BY quartile
```

3d: List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

```
SELECT country_name,
    region,
    ROUND(forest_area_pct :: NUMERIC, 2) AS pct_area
FROM   forestation
WHERE  forest_area_pct >= 75
    AND year = '2016'
ORDER  BY forest_area_pct DESC
```

3e: How many countries had a percent forestation higher than the United States in 2016?

```
SELECT Count(country_name) AS country_count
FROM   forestation
WHERE  forest_area_pct > (SELECT forest_area_pct
                    FROM   forestation
                    WHERE  country_name = 'United States'
                        AND year = '2016')
    AND year = '2016'
    AND country_name != 'World'
    AND forest_area_pct IS NOT NULL;
```