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 **41282696 sqkm** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958246 sqkm,** a loss of **1324449 sqkm**, or **3.21%.**

The forest area lost over this time period is slightly more than the entire land area of **Mongolia** listed for the year 2016 (which is 1553560 sqkm).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was **31.34%.** The region with the highest relative forestation was **Latin America,** 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 **32.38%.** 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
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & North Africa	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
South Asia	16.51	17.51
Sub-Saharan Africa	30.67	28.79

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Sub-Saharan Africa** (dropped from **30.67%** to **28.79%**) and **Latin America & Caribbean** (**51.03%** to **46.16%**). 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 sqkm.** 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 sqkm,** 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 **313.66%** 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	-541510.00
Indonesia	East Asia & Pacific	-282194.00
Myanmar	East Asia & Pacific	-107234.00
Nigeria	Sun-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	-61.8
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
1st	85
2nd	73
3rd	38
4th	9

The largest number of countries in 2016 were found in the **1ST** 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
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Lao PDR	East Asia & Pacific	82.11
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
Suriname	Latin America & Caribbean	98.26
Solomon Islands	East Asia & Pacific	77.86
Gabon	Sub-Saharan Africa	90.04

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's analysis indicates that global forest area continues to shrink, highlighting the need for heightened attention. Countries with the most significant percentage reduction in forest coverage, including Nigeria, Togo, Mauritania, Uganda, and Honduras, require particular focus.

  The analysis reveals a gradual disappearance of forests worldwide, with data showing a decline in global forest area between 1990 and 2016. Sub-Saharan Africa emerges as the most impacted region, exemplified by Togo's substantial 75.45% reduction in forest coverage. Additionally, when examining the distribution of countries based on their forestation percentages, we observe that 85 countries fall within the first quartile, having forestation levels ranging from 0% to 25%, while the second quartile comprises 72 countries with forestation levels between 25% and 50%.

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

  Four out of five of these countries are situated in the Sub-Saharan Africa region, all of which have low to lower-middle-income status. It is crucial to investigate the factors contributing to the decline in forest cover within these regions, such as the sourcing of exotic wood, agricultural practices, fires, and climate changes. An instructive example of a country that has managed to increase its forest area is China, and studying their case could provide valuable insights and recommendations for low-income countries.

  Among the countries with the highest percentage decrease in forest cover, four out of five are located in Sub-Saharan Africa. Togo, for instance, experienced a significant loss of over 75% of its forest during the analyzed period from 1990 to 2016. Other countries that demand our attention include Nigeria (61.80% reduction), Uganda (59.13% reduction), and Mauritania (46.75% reduction). It is crucial for people to recognize that our way of life often results in an unsustainable ecological footprint.

  To mitigate this issue, there are several steps that can be taken. Firstly, reducing personal consumption can help slow down the trend of deforestation, as decreased production of goods can have a positive impact. Secondly, it is important to avoid products containing palm oil, as its production contributes significantly to deforestation, particularly in Asia. Lastly, opting for sustainably certified products while shopping can contribute to minimizing ecological damage.

5. APPENDIX: SQL Queries Used

```
-- Creating forestation view

CREATE VIEW forestation
AS
SELECT fore_a.country_name,
       reg.region,
       fore_a.country_code,
       reg.income_group,
       fore_a.year,
       fore_a.forest_area_sqkm,
       (land_a.total_area_sq_mi * 2.59) AS total_area_sqkm,
       (fore_a.forest_area_sqkm / (land_a.total_area_sq_mi * 2.59)) * 100 AS forest_percent
  FROM forest_area fore_a
  JOIN land_area land_a
    ON fore_a.country_code = land_a.country_code
   AND fore_a.year         = land_a.year
  JOIN regions reg
    ON fore_a.country_code = reg.country_code

-- GLOBAL SITUATION

-- Total forest area (in sq km) of the world in 1990

SELECT ROUND(forest_area_sqkm) forest_area_1990
FROM forestation
WHERE year = 1990 AND country_name = 'World';

-- Total forest area (in sq km) of the world in 2016

SELECT ROUND(forest_area_sqkm) AS forest_area_2016
FROM forestation
WHERE year = 2016 AND country_name = 'World';
```

```
-- The change (in sq km) in the forest area of the world from 1990 to 2016

WITH total_forest_area_2016 AS(
        SELECT SUM(forest_area_sqkm) AS forest_area_sqkm_2016
        FROM forestation
        WHERE year = 2016 AND country_name = 'World'
),
total_forest_area_1990 AS(
        SELECT SUM(forest_area_sqkm)AS forest_area_sqkm_1990
        FROM forestation
        WHERE year = 1990 AND country_name = 'World'
)
SELECT
        (total_forest_area_2016.forest_area_sqkm_2016 -
    total_forest_area_1990.forest_area_sqkm_1990) AS forest_area_change
FROM
        total_forest_area_1990,
        total_forest_area_2016;


-- The change (in sq km) in the forest area of the world from 1990 to 2016
WITH total_area_2016 AS(
        SELECT SUM(forest_area_sqkm) AS forest_area_sqkm_2016
        FROM forestation
        WHERE year = 2016 AND country_name = 'World'
),
total_area_1990 AS(
        SELECT SUM(forest_area_sqkm)AS forest_area_sqkm_1990
        FROM forestation
        WHERE year = 1990 AND country_name = 'World'
)
SELECT
    ROUND((
                (total_area_2016.forest_area_sqkm_2016 -
                total_area_1990.forest_area_sqkm_1990)/
                (
                total_area_1990.forest_area_sqkm_1990)*100
      )::NUMERIC,2) AS forest_percentage_change
FROM
        total_area_1990,
        total_area_2016;
```

```
-- The amount of forest area lost between 1990 and 2016
-- Country's total area in 2016 is it closest to

SELECT country_name, total_area_sqkm
FROM forestation
WHERE total_area_sqkm >=(
   WITH total_area_2016 AS(
      SELECT SUM(forest_area_sqkm) AS forest_area_sqkm_2016
      FROM forestation
      WHERE year = 2016 AND country_name = 'World'
   ),
   total_area_1990 AS(
      SELECT SUM(forest_area_sqkm)AS forest_area_sqkm_1990
      FROM forestation
      WHERE year = 1990 AND country_name = 'World'
   )
   SELECT
        -(total_area_2016.forest_area_sqkm_2016 -
         total_area_1990.forest_area_sqkm_1990) AS forest_lost
   FROM
      total_area_1990,
      total_area_2016
)
ORDER BY total_area_sqkm
LIMIT 1;



-- REGIONAL OUTLOOK

-- Percent forest of the entire world in 2016

SELECT Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sqkm) ) * 100 ) ::
          NUMERIC, 2)
FROM   forestation
WHERE  year = 2016;
```

```
-- Region had the HIGHEST percent forest in 2016

SELECT region,
       forest_area,
       Round(( ( forest_area / land_area ) * 100 ) :: NUMERIC, 2) AS
       forest_percent
FROM   (SELECT region,
               Sum(forest_area_sqkm) AS forest_area,
               Sum(total_area_sqkm)  AS land_area
        FROM   forestation
        GROUP  BY region,
                  year
        HAVING year = 2016) AS total
ORDER  BY forest_percent DESC
LIMIT  1;

-- and which had the LOWEST, to 2 decimal places
SELECT region,
       forest_area,
       Round(( ( forest_area / land_area ) * 100 ) :: NUMERIC, 2) AS
       forest_percent
FROM   (SELECT region,
               Sum(forest_area_sqkm) AS forest_area,
               Sum(total_area_sqkm)  AS land_area
        FROM   forestation
        GROUP  BY region,
                  year
        HAVING year = 1990) AS total
ORDER  BY forest_percent DESC
LIMIT  1;
-- The percent forest of the entire world in 1990
SELECT Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sqkm) ) * 100 ) ::
           NUMERIC, 2)
FROM   forestation
WHERE  year = 1990 ;
```

```
-- Region had the HIGHEST percent forest in 1990

SELECT region,
       forest_area,
       Round(( ( forest_area / land_area ) * 100 ) :: NUMERIC, 2) AS
       forest_percent
FROM   (SELECT region,
               Sum(forest_area_sqkm) AS forest_area,
               Sum(total_area_sqkm)  AS land_area
        FROM   forestation
        GROUP  BY region,
                  year
        HAVING year = 1990) AS total
ORDER  BY forest_percent DESC
LIMIT  1;

-- And which had the LOWEST, to 2 decimal places

SELECT region,
       forest_area,
       ROUND(( ( forest_area / land_area ) * 100 ) :: NUMERIC, 2) AS
       forest_percent
FROM   (SELECT region,
               SUM(forest_area_sqkm) AS forest_area,
               SUM(total_area_sqkm)  AS land_area
        FROM   FORESTATION
        GROUP  BY region,
                  year
        HAVING year = 1990) AS total
ORDER  BY forest_percent ASC
LIMIT  1;
```

```
-- Regions of the world DECREASED in forest area from 1990 to 2016

WITH table_1
    AS (SELECT region,
               forest_area,
               ROUND(( ( forest_area / land_area ) * 100 ) :: NUMERIC, 2) AS
                 forest_percent
        FROM   (SELECT region,
                       SUM(forest_area_sqkm) AS forest_area,
                       SUM(total_area_sqkm)  AS land_area
                FROM   FORESTATION
                GROUP  BY region,
                          year
                HAVING year = 1990) AS total
        ORDER  BY forest_percent),
    table_2
    AS (SELECT region,
               forest_area,
               ROUND(( ( forest_area / land_area ) * 100 ) :: NUMERIC, 2) AS
                 forest_percent
        FROM   (SELECT region,
                       SUM(forest_area_sqkm) AS forest_area,
                       SUM(total_area_sqkm)  AS land_area
                FROM   FORESTATION
                GROUP  BY region,
                          year
                HAVING year = 2016) AS total
        ORDER  BY forest_percent)
SELECT TABLE_1.region,
       TABLE_2.forest_percent - TABLE_1.forest_percent AS
       forest_percentage_change
FROM   table_1
       join table_2
         ON TABLE_1.region = TABLE_2.region
            AND TABLE_1.forest_percent < TABLE_2.forest_percent
ORDER  BY forest_percentage_change;
```

```
-- COUNTRY-LEVEL DETAIL

-- 5 countries saw the largest amount decrease in forest area from 1990 to 2016
-- The difference in forest area for each

WITH table_1 AS
(
      SELECT region,
            country_name,
            forest_area_sqkm
      FROM   forestation
      WHERE  year = 1990 ),
table_2 AS
(
      SELECT region,
            country_name,
            forest_area_sqkm
      FROM   forestation
      WHERE  year = 2016 )
SELECT   table_1.region,
        table_1.country_name,
        table_1.forest_area_sqkm                                    AS forest_1990,
        table_2.forest_area_sqkm                                    AS forest_2016,
        Round( Cast( ( table_1.forest_area_sqkm - table_2.forest_area_sqkm ) AS NUMERIC ), 2
) AS forest_change
FROM     table_1
JOIN     table_2
ON       table_1.country_name = table_2.country_name
WHERE    table_2.forest_area_sqkm < table_1.forest_area_sqkm
AND      table_1.region NOT LIKE 'World'
ORDER BY forest_change DESC LIMIT 5;
```

```
-- 5 countries saw the largest percent decrease in forest area from 1990 to 2016
-- The percent change to 2 decimal places for each

WITH table_1 AS
(
      SELECT region,
            country_name,
            forest_area_sqkm
      FROM   forestation
      WHERE  year = 1990 ), table_2 AS
(
      SELECT region,
            country_name,
            forest_area_sqkm
      FROM   forestation
      WHERE  year = 2016 )
SELECT   table_1.region,
        table_1.country_name,
        table_1.forest_area_sqkm                                    AS forest_area_1990,
        table_2.forest_area_sqkm                                    AS forest_area_2016,
        Round( Cast( ( table_1.forest_area_sqkm - table_2.forest_area_sqkm ) AS
NUMERIC ), 2 ) AS difference,
        Round( Cast( ( ( table_1.forest_area_sqkm - table_2.forest_area_sqkm )* 100 /
table_1.forest_area_sqkm ) AS NUMERIC ), 2 ) AS percentage_decrease
FROM     table_1
JOIN     table_2
ON       table_1.country_name = table_2.country_name
WHERE    table_2.forest_area_sqkm < table_1.forest_area_sqkm
ORDER BY percentage_decrease DESC LIMIT 5;
```

```
-- countries grouped by percent forestation in quartiles
-- Group with the most countries in it in 2016

WITH country_forest_perc
    AS (SELECT country_name,
            CASE
              WHEN forest_percent < 25 THEN '0-25%'
              WHEN forest_percent >= 25
                  AND forest_percent < 50 THEN '25-50%'
              WHEN forest_percent >= 50
                  AND forest_percent < 75 THEN '50-75%'
              ELSE '75-100%'
            END AS quartile
        FROM   FORESTATION
        WHERE  year = 2016
            AND forest_percent IS NOT NULL)
SELECT DISTINCT quartile,
            ( Count(country_name)
               OVER (
                 partition BY quartile) ) AS count
FROM   country_forest_perc
ORDER  BY quartile;

-- All of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

WITH fourth_quartile_country
    AS (SELECT country_name,
            CASE
              WHEN forest_percent < 25 THEN '0-25%'
              WHEN forest_percent >= 25
                  AND forest_percent < 50 THEN '25-50%'
              WHEN forest_percent >= 50
                  AND forest_percent < 75 THEN '50-75%'
              ELSE '75-100%'
            END AS quartile
        FROM   FORESTATION
        WHERE  year = 2016
            AND forest_percent IS NOT NULL)
SELECT country_name,
      quartile
FROM   fourth_quartile_country
WHERE  quartile = '75-100%';
```

```
-- Number of countries had a percent forestation higher than the United States in 2016

SELECT Count(*) AS count
FROM   (SELECT DISTINCT country_name
       FROM   FORESTATION
       WHERE  forest_percent > (SELECT forest_percent
                         FROM   FORESTATION
                         WHERE  ( country_name = 'United States' )
                              AND year = 2016)
       ORDER  BY country_name) AS number_of_countries;
```