Report for ForestQuery into Global Deforestation, 1990 to 2016

ForestQuery is on a mission to combat deforestation worldwide and raise awareness about this topic and its environmental impact. 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 query them in an effort to find areas of concern and areas that present an opportunity to learn from successes.

1. **GLOBAL SITUATION**

According to the World Bank, the world's total forest area was 41282694.9 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9, a loss of 1324449 sqkm, or 3.21%.

The forest area lost over this time is slightly more than the entire land area listed for Peru in the year 2016 (which is 1279999.99 sqkm).

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
Middle East & North Africa	1.78	2.07
South Asia	16.51	17.51
East Asia & Pacific	25.78	26.36
Sub-Saharan Africa	30.67	28.79
World	32.42	31.38
North America	35.65	36.04
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16

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(dropped from 51.03% to 46.16%). All other regions increased in forest area over this time. However, the drop in forest area in the two regions mentioned above was so significant that the percentage of forest area in the world decreased from 32.42% to 31.38%.

3. **COUNTRY-LEVEL DETAIL**

A. SUCCESS STORIES

There is one exceptionally bright spot in the data at the country level, China. This country increased in forest area from 1990 to 2016 by 527229.06 sqkm. It would be interesting to study what has changed in this country to drive this figure in the data higher. The country with the subsequent largest increase in forest area from 1990 to 2016 was the United States, but it only saw a rise of 79200.00, much lower than the figure for China.

China and the United States are vast 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 three countries had the most significant reduction in forest area over the time under consideration: Brazil, Indonesia, and Myanmar.

Table 3.1: Top Five Amount Decrease in Forest Area by Country, 1990 & 2016:

Country	Region	Absolute Forest Area Change (sqkm)
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 Five 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 five countries on the list are in the region of Sub-Saharan Africa. The countries are Togo, Nigeria, Uganda, and Mauritania. The fifth country on the list is Honduras, in the Latin America & Caribbean region.

From the above analysis, we see that Nigeria is the only country that ranks in the top five in terms of absolute square kilometer decrease in forest and percent decrease in forest area from 1990 to 2016. Therefore, this country has a significant opportunity to stop the decline and hopefully spearhead remedial efforts.

C. QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

Quartile (Bins)	Number of Countries
0-25%	85
25-50%	72
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the first (0-25%) quartile.
There were nine countries in the top quartile in 2016. These countries have 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

According to World Bank data, the overall total forest area of the world decreased by 3.21% from 1990 to 2016. Looking at more specific data on the region level, we can observe that, although the forest area percentage increased for the majority of regions, the percent decrease in forest area from two regions was so large that the percent forest area of the world decreased over this time from 32.42% to 31.38%. Additionally, we can have a more narrow view of our data by observing the change and percent change in the forest area on a country level. We can see that, regarding the change in forest area in sqkm, the following three countries had the largest decrease in forest area: Brazil, Indonesia, and Myanmar. When we consider the percent decrease in forest area between 1990 and 2016, we find that of the top five countries on the list, four are in the region of Sub-Saharan Africa. The fifth country on the list is Honduras, in the Latin America & Caribbean region. Lastly, we can organize the data into quartiles, which helps to see a bigger picture of how a country ranks according to its percent of forest area. The largest number of countries in 2016 were found in the first quartile. There were nine countries in the top quartile in 2016.

According to our country-level data, we should focus primarily on Nigeria. In this analysis, Nigeria was a part of the top five countries that not only decreased in forest area in sqkm and had one of the largest decreases in the percentage of forest area from 1990 to 2016. Additionally, it may be beneficial to focus on Togo and Uganda as they also had large decreases in the percentage of forest area from 1990 to 2016. It is important to consider factors that may be causing deforestation in these countries as their percentage decreases are quite large during this time. I also recommend examining strategies used by China to increase forestation as there was evidence they achieved the most significant increase in forest area from 1990 to 2016.

6. APPENDIX: QUERIES

-INTRODUCTION-

Create “forestation” View:

```
CREATE VIEW forestation AS (
  SELECT
    f.country_code AS country_code,
    f.country_name AS country_name,
    f.year AS year,
    f.forest_area_sqkm AS forest_area_sqkm,
    l.total_area_sq_mi AS total_area_sqmi,
    r.region AS region,
    r.income_group AS income_group,
    (f.forest_area_sqkm * 100) / (l.total_area_sq_mi * 2.59) AS forest_percentage,
    l.total_area_sq_mi * 2.59 AS total_area_sqkm
  FROM
    forest_area AS f
    JOIN land_area AS l ON f.country_code = l.country_code
    AND f.year = l.year
    JOIN regions AS r ON r.country_code = f.country_code
)
```

1. GLOBAL SITUATION

1. **Total forest area of World in 1990 (sqkm) -** 41282694.9

```
SELECT
  country_name,
  forest_area_sqkm
FROM
  forestation
WHERE
  year = 1990
  AND country_name = 'World'
```

2. **Total forest area of World in 2016 (sqkm) -** 39958245.9

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

USING A SELF-JOIN

```
SELECT
  a.country_name AS world_1990,
  a.forest_area_sqkm AS fa_1990,
  b.country_name AS world_2016,
  b.forest_area_sqkm AS fa_2016
FROM
  forestation AS a, forestation AS b
WHERE
  a.year = 1990
  AND a.country_name = 'World' AND b.year = 2016 AND b.country_name = 'World'
```

3. **Difference between forest area from 1990 and 2016 -** 1324449

USING SCALAR:

```
SELECT
  (
    SELECT
      forest_area_sqkm
    FROM
      forestation
    WHERE
      year = 1990
      AND country_name = 'World'
  ) - (
    SELECT
      forest_area_sqkm
    FROM
      forestation
    WHERE
      year = 2016
```

```
    AND country_name = 'World'
  )
```

USING CTE:

```
WITH t1 AS (SELECT
  country_name,
  forest_area_sqkm
FROM
  forestation
WHERE
  year = 1990
  AND country_name = 'World'),
  t2 AS (SELECT
  country_name,
  forest_area_sqkm
FROM
  forestation
WHERE
  year = 2016
  AND country_name = 'World')

SELECT t1.country_name,
(t1.forest_area_sqkm - t2.forest_area_sqkm) AS difference
FROM t1
JOIN t2
ON t1.country_name = t2.country_name
```

4. **Percentage of forest area lost in the World from 1990 to 2016 (SELECT (((1st sub)-(2nd sub)) / (1st sub)) * 100) -** 3.21%

```
SELECT
  (
    (
      (
        SELECT
          forest_area_sqkm
        FROM
          forestation
        WHERE
          year = 1990
          AND country_name = 'World'
      ) - (
        SELECT
```

```
      forest_area_sqkm
    FROM
      forestation
    WHERE
      year = 2016
      AND country_name = 'World'
  )
 ) / (
  SELECT
    forest_area_sqkm
  FROM
    forestation
  WHERE
    year = 1990
    AND country_name = 'World'
 )
) * 100
```

5 and 6: The country whose total land area is slightly less than the forest area lost of World- Peru and 1279999.99

```
SELECT
  country_name,
  total_area_sqkm --land_area
FROM
  forestation
WHERE
  year = 2016
  AND total_area_sqkm < 1324449
ORDER BY
  2 DESC
LIMIT
  1
```

2. **REGIONAL OUTLOOK**

1. **Total percent distribution of forest in the world in 2016-** 31.38%

```
SELECT
  ROUND(forest_percentage :: numeric, 2) AS forest_percentage
FROM
  forestation
WHERE
  year = 2016
  AND country_name = 'World'
```

2 and 3: Region with the most relative forestation in 2016- Latin America & Caribbean, 46.16%

```
SELECT
  region,
  ROUND(
      (
       SUM(forest_area_sqkm)/ SUM(total_area_sqmi * 2.59)
      ) * 100
    ) :: numeric,
    2
  ) AS region_forest_percentage
FROM
  forestation
WHERE
  year = 2016
GROUP BY
  1
ORDER BY
  2 DESC
LIMIT
  1
```

4 and 5: Region with the lowest relative forestation in 2016- Middle East & North Africa, 2.07%

```
SELECT
  region,
  ROUND(
    (
      (
        SUM(forest_area_sqkm)/ SUM(total_area_sqmi * 2.59)
      ) * 100
    ) :: numeric,
    2
  ) AS region_forest_percentage
FROM
  forestation
WHERE
  year = 2016
GROUP BY
  1
ORDER BY
  2
LIMIT
  1
```

6. Total percent distribution of forest in the world in 1990- 32.42%

```
SELECT
  ROUND(forest_percentage :: numeric,  2) AS forest_percentage
FROM
  forestation
WHERE
  year = 1990
  AND country_name = 'World'
```

7 and 8: Region with the highest forestation in 1990- Latin America & Caribbean, 51.03%

```
SELECT
  region,
  ROUND(
    (
      (
        SUM(forest_area_sqkm)/ SUM(total_area_sqmi * 2.59)
      ) * 100
```

```
    ) :: numeric,
    2
  ) AS region_forest_percentage
FROM
  forestation
WHERE
  year = 1990
GROUP BY
  1
ORDER BY
  2 DESC
LIMIT
  1
```

9 and 10: Region with the lowest forestation in 1990- Middle East & North Africa, 1.78%

```
SELECT
  region,
  ROUND(
    (
      (
        SUM(forest_area_sqkm)/ SUM(total_area_sqmi * 2.59)
      ) * 100
    ) :: numeric,
    2
  ) AS region_forest_percentage
FROM
  forestation
WHERE
  year = 1990
GROUP BY
  1
ORDER BY
  2
LIMIT
  1
```

TABLE 2.1 - CTE to show forestation in 1990 and 2016

```
WITH forest_percentage_1990 AS (
  SELECT
    region,
    ROUND(
      (
        (
          SUM(forest_area_sqkm)/ SUM(total_area_sqmi * 2.59)
        ) * 100
      ) :: numeric,
      2
    ) AS forest_percentage_90
  FROM
    forestation
  WHERE
    year = 1990
  GROUP BY
    1
  ORDER BY
    2
),
forest_percentage_2016 AS (
  SELECT
    region,
    ROUND(
      (
        (
          SUM(forest_area_sqkm)/ SUM(total_area_sqmi * 2.59)
        ) * 100
      ) :: numeric,
      2
    ) AS forest_percentage_16
  FROM
    forestation
  WHERE
    year = 2016
  GROUP BY
    1
  ORDER BY
    2
),
joined_1990_2016 AS (
```

```
  SELECT
    fp90.region,
    fp90.forest_percentage_90,
    fp16.forest_percentage_16
  FROM
    forest_percentage_1990 AS fp90
    JOIN forest_percentage_2016 AS fp16 ON fp90.region = fp16.region
)

SELECT *
FROM
   joined_1990_2016
```

3. **COUNTRY-LEVEL DETAIL**

A. SUCCESS STORIES

CTE to create joined tables showing forest area per country

```
WITH forest_area_1990 AS (
  SELECT
    country_name,
    forest_area_sqkm,
    year

FROM
    forestation
  WHERE
    year = 1990
),
forest_area_2016 AS (
  SELECT
    country_name,
    forest_area_sqkm,
    year
  FROM
    forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
```

```
  SELECT
    fa90.country_name,
    fa90.forest_area_sqkm AS forest_area_sqkm_90,
    fa90.year AS year_90,
    fa16.forest_area_sqkm AS forest_area_sqkm_16,
    fa16.year AS year_16
  FROM
    forest_area_1990 AS fa90
    JOIN forest_area_2016 AS fa16 ON fa90.country_name = fa16.country_name
)
```

1-7. Query calculating forest area increase (sqkm) from 1990 to 2016 by country- China, 527229.06, United States, 79200.00

```
SELECT
  country_name,
  ROUND(
    (
      forest_area_sqkm_16 - forest_area_sqkm_90
    ):: numeric,
    2
  ) AS area_increase
FROM
  joined_1990_2016
WHERE


  forest_area_sqkm_16 > forest_area_sqkm_90
ORDER BY
  2 DESC
```

8 and 9: CTE to create joined tables showing forest area percentage by country

```
WITH fp_1990 AS (
  SELECT
    country_name,
    forest_percentage AS forest_area_percent_1990
  FROM
    forestation
  WHERE
```

```
    year = 1990
),
fp_2016 AS (
  SELECT
    country_name,
    forest_percentage AS forest_area_percent_2016
  FROM
    forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
  SELECT
    fp90.country_name AS country_name,
    fp90.forest_area_percent_1990 AS area_per_90,
    fp16.forest_area_percent_2016 AS area_per_16
  FROM
    fp_1990 AS fp90
    JOIN fp_2016 AS fp16 ON fp90.country_name = fp16.country_name
)
```

8 and 9 (cont.): Largest forest area percent increase by country- Iceland, 213.66%

```
SELECT
  country_name,
  ROUND(
    (
      (area_per_16 - area_per_90)/ area_per_90 * 100
    ):: numeric,
    2
  ) AS highest_percent_growth
FROM
  joined_1990_2016
WHERE
  area_per_16 > area_per_90 --need to avoid negative values
ORDER BY
  2 DESC
LIMIT
  1
```

B. LARGEST CONCERNS

TABLE 3.1: CTE to create joined tables showing forest area per country and region

```
WITH forest_area_1990 AS (
  SELECT
    country_name,
    region,
    forest_area_sqkm,
    year
  FROM
    forestation
  WHERE
    year = 1990
),
forest_area_2016 AS (
  SELECT
    country_name,
    forest_area_sqkm,
    year
  FROM

forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
  SELECT
    fa90.country_name,
    fa90.forest_area_sqkm AS forest_area_sqkm_90,
    fa90.year AS year_90,
    fa16.forest_area_sqkm AS forest_area_sqkm_16,
    fa16.year AS year_16
  FROM
    forest_area_1990 AS fa90
    JOIN forest_area_2016 AS fa16 ON fa90.country_name = fa16.country_name
)
```

TABLE 3.1: Query to show top five decrease in forest area by country and region

```
SELECT
  country_name AS country,
  region,
  ROUND(
    ABS(
      (
        forest_area_sqkm_90 - forest_area_sqkm_16
      )
    ):: numeric,
    2
  ) AS abs_forest_area_change
FROM
  joined_1990_2016
WHERE
  forest_area_sqkm_16 < forest_area_sqkm_90
  AND country_name != 'World'
ORDER BY
  3 DESC
LIMIT
  5
```

TABLE 3.2: CTE to create joined tables showing country name, region, and percent of forest area

```
WITH fp_1990 AS (
  SELECT
    country_name,
          region,
    forest_percentage AS forest_area_percent_1990
  FROM
    forestation
  WHERE
    year = 1990
),
fp_2016 AS (
  SELECT
    country_name,
    forest_percentage AS forest_area_percent_2016
  FROM
    forestation
  WHERE
```

```
    year = 2016
),
joined_1990_2016 AS (
  SELECT
    fp90.country_name AS country_name,
          fp90.region AS region,
    fp90.forest_area_percent_1990 AS area_per_90,
    fp16.forest_area_percent_2016 AS area_per_16
  FROM
    fp_1990 AS fp90
    JOIN fp_2016 AS fp16 ON fp90.country_name = fp16.country_name
)
```

TABLE 3.2: **1-8 Query to find the top 5 percent decrease in forest area**

```
SELECT
  country_name,
  region,
  ROUND(
    (
      (area_per_90 - area_per_16)/ area_per_90 * 100
    ):: numeric,

 2
  ) AS percent_forest_area_change
FROM
  joined_1990_2016
WHERE
  area_per_90 > area_per_16
ORDER BY
  3 DESC
LIMIT
  5
```

C.QUARTILES

TABLE 3.3: 1-2 Query to find 2016 quartiles and count of countries in each- 0-25%, 9

For CASE statement:

```
WHEN f16>= 75 THEN '4th_q'
WHEN f16>= 50 '3rd_q' ..
WHEN f16>=25 '2nd_q' ..
```

```
SELECT
  CASE WHEN forest_percentage < 25 THEN '0-25%'
 WHEN forest_percentage >= 25
  AND forest_percentage < 50 THEN '25-50%'
WHEN forest_percentage >= 50 AND forest_percentage < 75 THEN '50-75%'
WHEN forest_percentage >= 75 THEN '75-100%'
ELSE 'NULL' END AS quartiles,
  COUNT(country_name) AS num_of_countries
FROM
  forestation
WHERE
  year = 2016 AND  country_name != ‘World’
GROUP BY
  1
ORDER BY
  1
```

TABLE 3.4: Query to find all countries in top (75-100%) quartile

```
SELECT country_name
          , region
    , ROUND(forest_percentage::numeric, 2) AS forest_area_percentage
FROM forestation
WHERE year = 2016
          AND forest_percentage >= 75
   AND forest_percentage <= 100
 ORDER BY 3 DESC
```