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 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, 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 1279999.9891).

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
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
North America	35.65	36.04
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
World	32.42	31.38

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. 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, 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: Brazil, Indonesia, Myanmar

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	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 ofSub-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
0-25%	85
25-50%	73
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the first 0-25% 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
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

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

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

I learned from the World Bank data, that the total forest area in the world decreased from 41,282,694.9 sq. km in 1990 to 39,958,245.9 sq. km in 2016 which is a loss of 3.2%. Even though China and the United States are 2 countries whose forest area increased from 1990 to 2016, the only regions of the world that decreased in percent forest area were Latin America & Caribbean and Sub-Saharan Africa. In comparison to Iceland, with a smaller sq. km, their forest area increased between 1990 and 2016.

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

I would focus on the countries with the largest absolute forest area change, which are Brazil, Indonesia, Myanmar, Nigeria, and Tanzania. While looking at countries that have high percentage forestation decrease is useful, maybe focusing on the countries that are reducing the most forest by land area is most important. For example, China can help us to find best practices for increasing forest area.

Appendix:

CREATE VIEW:

```
CREATE VIEW forestation AS (
  SELECT
    f.country_code AS country_cd,
    f.country_name AS country_nm,
    f.year AS year,
    f.forest_area_sqkm AS forest_area_sqkm,
    l.total_area_sq_mi AS total_land_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 = l.country_code
)
```

1. GLOBAL SITUATION:

A. What was the total forest area (in sq km) of the world in 1990? 41282694.9

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

B. What was the total forest area (in sq km) of the world in 2016? 39958245.9

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

C. Difference between forest area from 1990 AND 2016 1324449

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

```
  SELECT
    forest_area_sqkm
  FROM
    forestation
  WHERE
    country_nm = 'World'
    AND year = '2016'
) AS change_between_years
```

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

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

E. Country whose country land area is slightly less than forest area of world 3.21%

```
SELECT
  country_nm,
  total_area_sqkm AS forest_area_lost
FROM
  forestation
WHERE
  year = 2016
  AND total_area_sqkm <= 1324449
ORDER BY
  2 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?

ENTIRE WORLD 2016: 31.38

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

HIGHEST PERCENT: Latin America & Caribbean 46.16

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

```
ORDER BY
  2 DESC
LIMIT
  1
```

LOWEST PERCENT: Middle East & North Africa 2.07

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

ENTIRE WORLD 1990: 32.42

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

HIGHEST: Latin America & Caribbean 51.03

```
SELECT
  region,
  ROUND(
    (
```

```
      (
        SUM(forest_area_sqkm)/ SUM(total_land_sqmi * 2.59)
      ) * 100
    ) :: numeric,
    2
  ) AS forest_percentage
FROM
  forestation
WHERE
  year = 1990
GROUP BY
  1
ORDER BY
  2 DESC
LIMIT
  1
```

LOWEST: Middle East & North Africa 1.78

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

C. ***Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016? TABLE 2.1***

```
WITH forest_percentage_1990 AS (
```

```
  SELECT
    region,
    ROUND(
      (
        (
          SUM(forest_area_sqkm)/ SUM(total_land_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_land_sqmi * 2.59)
        ) * 100
      ) :: numeric,
      2
    ) AS forest_percentage_16
  FROM
    forestation
  WHERE
    year = 2016
  GROUP BY
    1
  ORDER BY
    2 DESC
),
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

SUCCESS STORIES

A. WITH subquery to create jounes tables showing forest area per country level: China, United States,

```
WITH forest_area_1990 AS (
  SELECT
    country_nm,
    forest_area_sqkm,
    year
  FROM
    forestation
  WHERE
    year = 1990
),
forest_area_2016 AS (
  SELECT
    country_nm,
    forest_area_sqkm,
    year
  FROM
    forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
  SELECT
    fa90.country_nm,
    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_nm = fa16.country_nm
)

SELECT
  country_nm,
  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
```

B. Iceland increased in forest area by 213.66% from 1990 to 2016

```
WITH fp_1990 AS (
  SELECT
    country_nm,
    forest_percentage AS forest_area_percent_1990
  FROM
    forestation
  WHERE
    year = 1990
),
fp_2016 AS (
  SELECT
    country_nm,
    forest_percentage AS forest_area_percent_2016
  FROM
    forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
```

```
  SELECT
    fp90.country_nm 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_nm = fp16.country_nm
)
SELECT
  country_name,
  ROUND(
    (
      (area_per_16 - area_per_90) / area_per_90 * 100
    ) :: numeric,
    2
  ) AS highest_percentage_growth
FROM
  joined_1990_2016
WHERE
  area_per_16 > area_per_90
ORDER BY
  2 DESC
LIMIT
  1
```

3. LARGEST CONCERNS

a. ***The following 3 countries had the largest decrease in forest area over the time period under consideration: <u>Brazil, Indonesia, Myanmar</u>***

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

```
    region,
    forest_area_sqkm,
    year
  FROM
    forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
  SELECT
    fa90.country_nm,
    fa90.region,
    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_nm = fa16.country_nm
)
SELECT
  country_nm AS country_name,
  region,
  (
    ROUND(
      ABS(
        forest_area_sqkm_90 - forest_area_sqkm_16
      ):: numeric,
      2
    )
  ) AS abs_value_forest_area
FROM
  joined_1990_2016
WHERE
  forest_area_sqkm_16 < forest_area_sqkm_90
ORDER BY
  3 DESC
LIMIT
  6
```

b. Table 3.2 - Percent Decrease in Forest Area by Country, 1990 & 2016:

```
WITH fp_1990 AS (
```

```
  SELECT
    country_nm,
    region,
    forest_percentage AS forest_area_percent_1990
  FROM
    forestation
  WHERE
    year = 1990
),
fp_2016 AS (
  SELECT
    country_nm,
    forest_percentage AS forest_area_percent_2016
  FROM
    forestation
  WHERE
    year = 2016
),
joined_1990_2016 AS (
  SELECT
    fp90.country_nm 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_nm = fp16.country_nm
)
SELECT
  country_name,
  region,
  ROUND(
    (
      (area_per_90 - area_per_16) / area_per_90 * 100
    ):: numeric,
    2
  ) AS percentage_forest_area
FROM
  joined_1990_2016
WHERE
  area_per_90 > area_per_16
ORDER BY
  3 DESC
```

```
LIMIT
  5
```

QUARTILES

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

```
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 'No data' END AS quartiles,
  COUNT(country_nm)
FROM
  forestation
WHERE
  year = '2016'
GROUP BY
  1
```

Table 3.4 - Top Quartile Countries, 2016:

```
SELECT country_nm
, 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
```