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 **41,282,694.9** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9**, a loss of **1,324,449**, 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 **1,279,999.99** square kilometers).

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

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 **527,229.062**. 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 **79,200**, 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**	**Absolute Forest Area Change**
Brazil	Latin America and Caribbean	541,510
Indonesia	East Asia and Pacific	282,193.98
Myanmar	East Asia and Pacific	107,234
Nigeria	Sub-Saharan Africa	106,506
Tanzania	Sub-Saharan Africa	102,320

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 and 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 and 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 **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
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

5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
- *Which countries should we focus on over others?*

I learned that many regions in the world are increasing in the forest area and forest area percentage. Although the world has decreased in forest area from 1990 to 2016.

I would focus on countries with the largest forest area change. Such countries are Brazil, Indonesia, Myanmar, Nigeria, and Tanzania. I think focusing on countries that are reducing the most forest area are important.

APPENDIX

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW Forestation AS
SELECT
  r.country_name,
  f.year,
  r.income_group,
  r.region,
  l.total_area_sq_mi,
  f.forest_area_sqkm,
  (
    (
      Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2.59)
    ) * 100
  ) percentage_forest
FROM
  forest_area f
  FULL JOIN land_area l ON f.country_code = l.country_code
  AND f.year = l.year
  FULL JOIN regions r ON r.country_code = f.country_code
GROUP BY
  r.country_name,
  f.year,
  r.income_group,
  r.region,
  l.total_area_sq_mi,
  f.forest_area_sqkm;

SELECT * FROM forestation;

-- 1A & 1B
SELECT
  *
FROM
  forest_area
WHERE
  country_name = 'World'
  AND (
    year = 2016
    OR year = 1990
  );
```

```
-- 1C
SELECT
  previous.forest_area_sqkm - current.forest_area_sqkm As difference
FROM
  forest_area AS previous
  INNER JOIN forest_area AS current ON (
    current.year = 2016
    AND previous.year = 1990
    AND current.country_name = 'World'
    AND previous.country_name = 'World'
  );

-- 1D
SELECT
  ROUND(
    (
      (
        (
          previous.forest_area_sqkm - current.forest_area_sqkm
        ) * 100
      ) / previous.forest_area_sqkm
    ):: Numeric, 2
  ) AS percentage
FROM
  forest_area AS current
  INNER JOIN forest_area AS previous ON
  (
    current.year = '2016'
    AND previous.year = '1990'
    AND current.country_name = 'World'
    AND previous.country_name = 'World'
  );

-- 1E & 1F
SELECT
  l.country_name,
  l.total_area_sq_mi * 2.59 AS total_area_sqkm,
  ABS(
    (l.total_area_sq_mi * 2.59) - (
      SELECT
        sub1.forest_area_sqkm - sub2.forest_area_sqkm AS diff_forest_area_sq_km
      FROM
        (
          SELECT
```

```
        f.country_code AS cc,
        f.forest_area_sqkm
      FROM
        forest_area f
      WHERE
        f.country_name = 'World'
        AND f.year = 1990
    ) AS sub1
    LEFT JOIN (
      SELECT
        f.country_code AS cc,
        f.forest_area_sqkm
      FROM
        forest_area f
      WHERE
        f.country_name = 'World'
        AND f.year = 2016
    ) AS sub2 ON sub1.cc = sub2.cc
  )
 ) AS diff_fa_la_sqkm
FROM
 land_area l
WHERE
 l.year = 2016
ORDER BY 3
LIMIT 1;

-- Part II Regional Outlook
-- 2A
SELECT
 country_name,
 ROUND(
  (
   (
    SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
   ) * 100
  ):: Numeric, 2
 ) AS percentage_forest
FROM
 forestation
WHERE
 year = 2016
 AND country_name = 'World'
GROUP BY
```

```
  country_name;

-- 2B-F
SELECT
  region,
  ROUND(
    (
      (
        SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
      ) * 100
    ):: Numeric, 2
  ) AS percent_forest
FROM
  forestation
WHERE
  year = 2016
GROUP BY
  region
ORDER BY
  percent_forest DESC;

-- 2F
SELECT
  country_name,
  ROUND(
    (
      (
        SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
      ) * 100
    ):: Numeric, 2
  ) AS percent_forest
FROM
  forestation
WHERE
  year = 1990
  AND country_name = 'World'
GROUP BY
  country_name;
```

```
-- 2G-J / Table 2.1 1990 data
SELECT
  region,
  ROUND(
    (
      (
        SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
      ) * 100
    ):: Numeric, 2
  ) AS percent_forest
FROM
  forestation
WHERE
  year = 1990
GROUP BY
  region
ORDER BY
  percent_forest DESC;

-- Table 2.1 2016 data
SELECT
  region,
  Round(
    (
      (
        Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2.59)
      )* 100
    ):: Numeric, 2
  ) AS percent_forest
FROM
  Forestation
WHERE
  YEAR = 2016
GROUP BY
  region
ORDER BY
  percent_forest DESC;
```

```
-- 3A.1
WITH t1 AS (
  SELECT
    country_name,
    SUM(forest_area_sqkm) forest_area_1
  FROM
    forestation
  WHERE
    YEAR = 1990
  GROUP BY
    country_name,
    forest_area_sqkm
),
t2 AS (
  SELECT
    country_name,
    SUM(forest_area_sqkm) forest_area_2
  FROM
    forestation
  WHERE
    YEAR = 2016
  GROUP BY
    country_name,
    forest_area_sqkm
)
SELECT
  f.country_name,
  (
    f.forest_area_1 - t.forest_area_2
  ) forest_change
FROM
  t1 f
  JOIN t2 t ON f.country_name = t.country_name
ORDER BY
  forest_change
LIMIT 2;

-- 3A.2
WITH forest_percentage_1990 AS
(
  SELECT
    country_name,
    (
```

```
      SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
    ) * 100 percent_forestation_1
  FROM
    forestation
  WHERE
    YEAR = 1990
  GROUP BY
    country_name,
    forest_area_sqkm
),
forest_percentage_2016 AS
(
  SELECT
    country_name,
    (
      SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
    ) * 100 percent_forestation_2
  FROM
    forestation
  WHERE
    YEAR = 2016
  GROUP BY
    country_name,
    forest_area_sqkm
)
SELECT
  f.country_name,
  ROUND(
    (
      (
        (
          f.percent_forestation_1 - t.percent_forestation_2
        )/(f.percent_forestation_1)
      ) * 100
    ):: Numeric, 2
  ) percent_change
FROM
  forest_percentage_1990 f
  JOIN forest_percentage_2016 t ON f.country_name = t.country_name
ORDER BY
  percent_change
LIMIT 1;
```

```
-- 3B Table 3.1
WITH t1 AS
(
  SELECT
    country_name,
    SUM(forest_area_sqkm) forest_area_1
  FROM
    forestation
  WHERE
    YEAR = 1990
  GROUP BY
    country_name,
    forest_area_sqkm
),
t2 AS
(
  SELECT
    country_name,
    SUM(forest_area_sqkm) forest_area_2
  FROM
    forestation
  WHERE
    YEAR = 2016
  GROUP BY
    country_name,
    forest_area_sqkm
)
SELECT
  f.country_name,
  ROUND(
    (
      f.forest_area_1 - t.forest_area_2
    ):: Numeric, 2
) forest_change
FROM
  t1 f
  JOIN t2 t ON f.country_name = t.country_name
WHERE
  f.forest_area_1 IS NOT NULL
  AND t.forest_area_2 IS NOT NULL
  AND f.country_name != 'World'
ORDER BY
  forest_change DESC
```

```
LIMIT 5;

-- Table 3.2
WITH forest_percentage_1990 AS
(
  SELECT
    country_name,
    (
      SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
    ) * 100 percent_forestation_1
  FROM
    forestation
  WHERE
    YEAR = 1990
  GROUP BY
    country_name,
    forest_area_sqkm
),
forest_percentage_2016 AS
(
  SELECT
    country_name,
    (
      SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
    ) * 100 percent_forestation_2
  FROM
    forestation
  WHERE
    YEAR = 2016
  GROUP BY
    country_name,
    forest_area_sqkm
)
SELECT
  f.country_name,
  Round(
    (
      (
        (
          f.percent_forestation_1 - t.percent_forestation_2
        ) / (f.percent_forestation_1)
      ) * 100
    ):: Numeric, 2
  ) percent_change
```

```
FROM
  forest_percentage_1990 f
  JOIN forest_percentage_2016 t ON f.country_name = t.country_name
WHERE
  f.percent_forestation_1 IS NOT NULL
  AND t.percent_forestation_2 IS NOT NULL
  AND f.country_name != 'World'
ORDER BY
  percent_change DESC
LIMIT 5;

-- 3C Table 3.3
With table1 AS
(
  SELECT
    f.country_code,
    f.country_name,
    f.year,
    f.forest_area_sqkm,
    l.total_area_sq_mi * 2.59 AS total_area_sqkm,
    (
      f.forest_area_sqkm /(l.total_area_sq_mi * 2.59)
    ) * 100 AS perc_fa
  FROM
    forest_area f
    JOIN land_area l ON f.country_code = l.country_code
    AND (
      f.country_name != 'World'
      AND f.forest_area_sqkm IS NOT NULL
      AND l.total_area_sq_mi IS NOT NULL
    )
    AND (
      f.year = 2016
      AND l.year = 2016
    )
  ORDER BY 6 DESC
),
table2 AS
(
  SELECT
    table1.country_code,
    table1.country_name,
    table1.year,
    table1.perc_fa,
```

```
    CASE WHEN table1.perc_fa >= 75 THEN '75-100%' WHEN table1.perc_fa < 75
    AND table1.perc_fa >= 50 THEN '50-75%' WHEN table1.perc_fa < 50
    AND table1.perc_fa >= 25 THEN '25-50%' ELSE '0-25%' END AS percentile
  FROM table1
  ORDER BY 5 DESC
)
SELECT
  table2.percentile,
  COUNT(table2.percentile)
FROM table2
GROUP BY 1
ORDER BY 2 DESC;

-- Table 3.4
SELECT
  country_name,
  region,
  percentage_forest
FROM
  forestation
WHERE
  percentage_forest > 75
  AND percentage_forest IS NOT NULL
  AND year = 2016
ORDER BY 3 DESC;
```