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 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sqkm, a loss of 1324449 sqkm, or 3.2%.

The forest area lost over this time period is slightly more than the entire land area of 1280000 sqkm listed for the year 2016 (which is Peru).

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%
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%
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 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, 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 & Caribbean	541510
Indonesia	East Asia & Pacific	282194
Myanmar	East Asia & Pacific	107234
Nigeria	Sub-Saharan Africa	106506
Tanzania	Sub-Saharan Africa	102320

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	59.13%
Mauritania	Sub-Saharan Africa	46.75%
Honduras	Latin America & 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 & 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
75-100	9
50-75	38
25-50	72
0-25	85

The largest number of countries in 2016 were found in the 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.

- *From this data it is clear to see the difference of forest cover rate among regions. Forest area is decreasing.*
- *We should focus on the countries whose forest area are decreasing.*

6. Appendix

```
# View
SELECT *
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
# 1-a,1-b
SELECT f.country_code, f.country_name, f.year,
    f.forest_area_sqkm, l.total_area_sq_mi,
    r.region, r.income_group,
    f.forest_area_sqkm/(l.total_area_sq_mi*2.59) AS precent_land_area
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE (f.year=1990 OR f.year=2016) AND region LIKE '%World%'

# 1-c,1-d
WITH t1 AS(SELECT f.country_code, f.country_name, f.year,
    f.forest_area_sqkm, l.total_area_sq_mi,
    r.region, r.income_group,
    f.forest_area_sqkm/(l.total_area_sq_mi*2.59) AS precent_land_area
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE (f.year=1990 OR f.year=2016) AND region LIKE '%World%')
```

```
SELECT year,forest_area_sqkm,
      forest_area_sqkm-LAG(forest_area_sqkm)OVER() AS difference,
      (forest_area_sqkm-LAG(forest_area_sqkm)OVER())/forest_area_sqkm AS ratio
FROM t1

# 1-e
SELECT country_name, total_area_sq_mi, total_area_sq_mi*2.59 AS total_area_sqkm
FROM land_area
WHERE year=2016 AND total_area_sq_mi<1324449/2.59
ORDER BY 2 DESC
LIMIT 1

# 2-a
WITH t1 AS (
SELECT f.country_code, f.country_name, f.year,
      f.forest_area_sqkm, l.total_area_sq_mi,
      r.region, r.income_group
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=2016)

SELECT region, year,
      SUM(forest_area_sqkm) AS sum_forest_area_sqkm,
      SUM(total_area_sq_mi*2.59) AS sum_total_area_sqkm,
      SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59) AS ratio
FROM t1
GROUP BY 2,1
ORDER BY 5 DESC

# 2-b
WITH t1 AS (
SELECT f.country_code, f.country_name, f.year,
      f.forest_area_sqkm, l.total_area_sq_mi,
      r.region, r.income_group
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=1990)
```

```
SELECT region, year,
    SUM(forest_area_sqkm) AS sum_forest_area_sqkm,
    SUM(total_area_sq_mi*2.59) AS sum_total_area_sqkm,
    SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59) AS ratio
FROM t1
GROUP BY 2,1
ORDER BY 5 DESC

# 2-c
WITH t2016 AS(
SELECT DISTINCT(region), f.year AS year_2016,
    SUM(forest_area_sqkm) OVER (PARTITION BY region) AS forest_area_sqkm,
    SUM(total_area_sq_mi*2.59) OVER (PARTITION BY region) AS total_area_sqkm,
    SUM(forest_area_sqkm) OVER (PARTITION BY region)/SUM(total_area_sq_mi*2.59)
OVER (PARTITION BY region) AS ratio_2016
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=2016
ORDER BY 4 DESC),

t1990 AS(
SELECT DISTINCT(region), f.year AS year_1990,
    SUM(forest_area_sqkm) OVER (PARTITION BY region) AS forest_area_sqkm,
    SUM(total_area_sq_mi*2.59) OVER (PARTITION BY region) AS total_area_sqkm,
    SUM(forest_area_sqkm) OVER (PARTITION BY region)/SUM(total_area_sq_mi*2.59)
OVER (PARTITION BY region) AS ratio_1990
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=1990
ORDER BY 4 DESC)

SELECT t2016.region, t2016.year_2016, t2016.ratio_2016,
    t1990.year_1990, t1990.ratio_1990
FROM t2016
JOIN t1990
ON t2016.region=t1990.region
WHERE ratio_2016<ratio_1990
```

```
# 3-a,b
WITH t1990 AS (
SELECT f.country_name AS name,
       f.country_code AS code,
       region AS region,
       f.year AS year_1990,
       f.forest_area_sqkm AS forest_area_sqkm_1990,
       l.total_area_sq_mi*2.59 AS total_area_sqkm_1990
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=1990),

t2016 AS (
SELECT f.country_name AS name,
       f.country_code AS code,
       region AS region,
       f.year AS year_2016,
       f.forest_area_sqkm AS forest_area_sqkm_2016,
       l.total_area_sq_mi*2.59 AS total_area_sqkm_2016
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=2016)

SELECT t1990.name, t1990.region,
       forest_area_sqkm_2016-forest_area_sqkm_1990 AS area_diff,
       (forest_area_sqkm_2016-forest_area_sqkm_1990)/forest_area_sqkm_1990  AS
area_diff_ratio
FROM t1990
JOIN t2016
ON t1990.code=t2016.code
ORDER BY 4

# 3-c
WITH t1 AS(
SELECT f.country_name AS name,
 f.country_code AS code,
 region AS region,
 f.year AS year_2016,
```

```
 f.forest_area_sqkm/(l.total_area_sq_mi*2.59) AS percent,
 CASE WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59) >=0.75 THEN 1
 WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0.50 THEN 2
 WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0.25 THEN 3
 WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0 THEN 4 END AS ntile
FROM forest_area f
JOIN land_area l ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=2016 AND region not LIKE '%World%')

SELECT ntile, COUNT(ntile)
FROM t1
GROUP BY 1

# 3-d
WITH t1 AS(
SELECT f.country_name AS name,
      f.country_code AS code,
      region AS region,
      f.year AS year_2016,
      f.forest_area_sqkm/(l.total_area_sq_mi*2.59) AS percent,
      CASE WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59) >=0.75 THEN 1
      WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0.50 THEN 2
      WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0.25 THEN 3
      WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0 THEN 4 END AS ntile
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=2016)

SELECT name, percent,region
FROM t1
WHERE ntile=1
ORDER BY 2 DESC

# 3-e
WITH t1 AS(
SELECT f.country_name AS name,
      f.country_code AS code,
      region AS region,
      f.year AS year_2016,
```

```
    f.forest_area_sqkm/(l.total_area_sq_mi*2.59) AS percent,
    CASE WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59) >=0.75 THEN 1
    WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0.50 THEN 2
    WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0.25 THEN 3
    WHEN f.forest_area_sqkm/(l.total_area_sq_mi*2.59)>=0 THEN 4 END AS ntile
FROM forest_area f
JOIN land_area l
ON f.country_code=l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
WHERE f.year=2016)

SELECT COUNT(name)
FROM t1
WHERE percent>(
  SELECT percent
  FROM t1
  WHERE name LIKE '%United States%')
```