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 41,282,695 [km ^ 2] in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,246 [km ^ 2], a loss of 1,324,449 [km ^ 2], 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 1,279,994 [km ^ 2]).

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 the 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 the 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
World	32.42	31.38
Latin America & Caribbean	51.03	46.16
The 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, that 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 [km^2], or by 33.55%. 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[km^2], or 2.62%, 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's forest area increased 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[km^2]
Brazil	Latin America & Caribbean	541,510
Indonesia	East Asia & Pacific	282,194
Myanmar	East Asia & 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	59.13
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 the forest as well as the 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
1	85
2	72*(excluding ‘world’)
3	38
4	9

The largest number of countries in 2016 were found in the first 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**	**Forested Pct**
Suriname	Latin America & Caribbean	98.2581450318777
Micronesia, Fed. Sts.	East Asia & Pacific	91.8576607536569
Gabon	Sub-Saharan Africa	90.0380551991003
Seychelles	Sub-Saharan Africa	88.4115426009477
Palau	East Asia & Pacific	87.6072107191201
American Samoa	East Asia & Pacific	87.500489180171
Guyana	Latin America & Caribbean	83.9018340711516
Lao PDR	East Asia & Pacific	82.1086086921822
Solomon Islands	East Asia & Pacific	77.8638752367129

4. RECOMMENDATIONS

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

- What have you learned from the World Bank data?
  I have learned a lot about the world's distribution of forests, and just how acute the deforestation of the Earth is, along with some surprising statistics, such as the growth of forests in Iceland since '90, and the sheer amount of vegetation added to China since '90.

- Which countries should we focus on over others?
  I believe we should focus primarily on these 5 countries:

Country	*Region*	*Forest Pct*
Greenland	**Europe & Central Asia**	**0.0005%**
Oman	**Middle East & North Africa**	**0.006%**
Faroe Islands	**Europe & Central Asia**	**0.057%**
Egypt, Arab Rep.	**Middle East & North Africa**	**0.074%**
Libya	**Middle East & North Africa**	**0.123%**

Above are listed the five countries which are the least populated by forests(percentage-wise). While striving to increase forestation worldwide is an idealistic goal, in my opinion, we should aim for a more realistic goal - to increase forestation in countries that are the least populated by trees(percentage-wise).

5. APPENDIX: SQL queries

**NOTE- Queries are ordered accordingly to the report data.*

1. GLOBAL SITUATION

```
SELECT year, forest_area_sqkm,
LEAD(forest_area_sqkm) OVER() - forest_area_sqkm AS diff
FROM forest_area
WHERE country_code = 'WLD' AND (year = 1990 OR year = 2016)
```

```
SELECT
ROUND(forest_area_sqkm - LAG(forest_area_sqkm) OVER()) AS diff,
ROUND(CAST((forest_area_sqkm - LAG(forest_area_sqkm) OVER()) /
forest_area_sqkm * 100 AS DECIMAL),2) AS per_decrease
FROM forest_area
WHERE country_code = 'WLD' AND (year = 1990 OR year = 2016)
```

```
WITH t1 AS (SELECT LEAD(forest_area_sqkm) OVER() -
forest_area_sqkm AS diff
FROM forest_area
WHERE country_code = 'WLD'
AND (year = 1990 OR year = 2016)),

t2 AS (SELECT MIN(ABS(l.total_area_sq_mi * 1.609344 ^ 2 - t1.diff))
smallest_diff FROM land_area l JOIN t1 ON l.country_code =
l.country_code)

SELECT l.country_name, l.total_area_sq_mi * 1.609344 ^ 2 land_in_km
FROM land_area l JOIN t1 ON l.country_code = l.country_code JOIN t2
ON
ABS(l.total_area_sq_mi * 1.609344 ^ 2 - t1.diff) = t2.smallest_diff
WHERE l.year = 2016
```

2.REGIONAL OUTLOOK

```
CREATE VIEW regional_forests AS
SELECT r.region,l.year, SUM(l.total_area_sq_mi * 1.609344 ^ 2) land,
SUM(f.forest_area_sqkm) forest,
ROUND(CAST(SUM(f.forest_area_sqkm) /
SUM(l.total_area_sq_mi * 1.609344 ^ 2) * 100 AS DECIMAL), 2) ratio
FROM regions r JOIN land_area l ON r.country_code = l.country_code
JOIN forest_area f ON
f.country_code = l.country_code AND l.year = f.year
GROUP BY region, l.year
ORDER BY region, l.year
```

```
SELECT * FROM regional_forests
WHERE year = 2016 AND region = 'World'
```

```
SELECT * FROM regional_forests
WHERE year = 2016 AND region != 'World'
ORDER BY ratio DESC
LIMIT 1
```

```
SELECT * FROM regional_forests
WHERE year = 2016 AND region != 'World'
ORDER BY ratio
LIMIT 1
```

```
SELECT * FROM regional_forests
WHERE year = 1990 AND region = 'World'
```

```
SELECT * FROM regional_forests
WHERE year = 1990 AND region != 'World'
ORDER BY ratio DESC
LIMIT 1
```

```
SELECT * FROM regional_forests
WHERE year = 1990 AND region != 'World'
ORDER BY ratio
LIMIT 1
```

```
WITH t1 AS (SELECT region, ratio FROM regional_forests
WHERE year = 1990),

t2 AS (SELECT region, ratio FROM regional_forests
WHERE year = 2016)

SELECT t1.region, t1.ratio r_90, t2.ratio r_16,
t2.ratio - t1.ratio delta
FROM t1 JOIN t2 ON t1.region = t2.region
WHERE t1.region != 'World' AND t2.ratio - t1.ratio < 0
```

```
t2 AS (SELECT region, ratio FROM regional_forests
WHERE year = 2016)

SELECT t1.region, t1.ratio r_90, t2.ratio r_16,
t2.ratio - t1.ratio delta
FROM t1 JOIN t2 ON t1.region = t2.region
WHERE t1.region = 'World'
```

3. COUNTRY-LEVEL OUTLOOK

A.SUCCESS STORIES

```
WITH t1 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),

t2 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL)

SELECT t1.country_name, t1.forest_area_sqkm f_90, t2.forest_area_sqkm f_16,
t2.forest_area_sqkm - t1.forest_area_sqkm delta
FROM t1 JOIN t2 ON t1.country_name = t2.country_name
WHERE t1.country_name != 'World'
ORDER BY delta DESC
LIMIT 2
```

```
WITH t1 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),

t2 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL)

SELECT t1.country_name, t1.forest_area_sqkm f_90, t2.forest_area_sqkm f_16,
ROUND(CAST((1 - t2.forest_area_sqkm / t1.forest_area_sqkm) * 100 AS
DECIMAL), 2) delta_percent, t2.forest_area_sqkm - t1.forest_area_sqkm delta
FROM t1 JOIN t2 ON t1.country_name = t2.country_name
WHERE t1.country_name != 'World'
ORDER BY delta_percent
LIMIT 1
```

B.LARGEST CONCERNS

```
WITH t1 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),

t2 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL)

SELECT t1.country_name, r.region, t1.forest_area_sqkm f_90,
t2.forest_area_sqkm f_16,
ROUND(CAST((1 - t2.forest_area_sqkm / t1.forest_area_sqkm) * 100 AS
DECIMAL), 2) delta_percent, t2.forest_area_sqkm - t1.forest_area_sqkm delta
FROM t1 JOIN t2 ON t1.country_name = t2.country_name
JOIN regions r ON r.country_name = t1.country_name
WHERE t1.country_name != 'World'
ORDER BY delta
LIMIT 5
```

```
WITH t1 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),

t2 AS (SELECT country_name, forest_area_sqkm FROM forest_area
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL)

SELECT t1.country_name, r.region, t1.forest_area_sqkm f_90,
t2.forest_area_sqkm f_16,
ROUND(CAST((1 - t2.forest_area_sqkm / t1.forest_area_sqkm) * 100 AS
DECIMAL), 2) delta_percent, t2.forest_area_sqkm - t1.forest_area_sqkm delta
FROM t1 JOIN t2 ON t1.country_name = t2.country_name
JOIN regions r ON r.country_name = t1.country_name
WHERE t1.country_name != 'World'
ORDER BY delta_percent DESC
LIMIT 5
```

C.QUARTILES

```
SELECT COUNT(forest_percent) FROM
(SELECT l.country_name, l.total_area_sq_mi * 1.609344 ^ 2 land,
f.forest_area_sqkm forest, f.forest_area_sqkm / (l.total_area_sq_mi * 1.609344 ^
2) * 100 forest_percent
FROM forest_area f JOIN land_area l ON
l.country_code = f.country_code AND l.year = f.year
WHERE l.country_name != 'World' AND l.year = 2016 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 < 25) AS q1
```

```
SELECT COUNT(forest_percent) FROM
(SELECT l.country_name, l.total_area_sq_mi * 1.609344 ^ 2 land,
f.forest_area_sqkm forest, f.forest_area_sqkm / (l.total_area_sq_mi * 1.609344 ^
2) * 100 forest_percent
FROM forest_area f JOIN land_area l ON
l.country_code = f.country_code AND l.year = f.year
WHERE l.country_name != 'World' AND l.year = 2016 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 > 25 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 < 50) AS q2
```

```
SELECT COUNT(forest_percent) FROM
(SELECT l.country_name, l.total_area_sq_mi * 1.609344 ^ 2 land,
f.forest_area_sqkm forest, f.forest_area_sqkm / (l.total_area_sq_mi * 1.609344 ^
2) * 100 forest_percent
FROM forest_area f JOIN land_area l ON
l.country_code = f.country_code AND l.year = f.year
WHERE l.country_name != 'World' AND l.year = 2016 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 > 50 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 < 75) AS q3
```

```
SELECT COUNT(forest_percent) FROM
(SELECT l.country_name, l.total_area_sq_mi * 1.609344 ^ 2 land,
f.forest_area_sqkm forest, f.forest_area_sqkm / (l.total_area_sq_mi * 1.609344 ^
2) * 100 forest_percent
FROM forest_area f JOIN land_area l ON
l.country_code = f.country_code AND l.year = f.year
WHERE l.country_name != 'World' AND l.year = 2016 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 > 75) AS q4
```

***** NOTE - I didn't use BETWEEN clause in order to consider values which are equal to limits.***

```
SELECT l.country_name, r.region, f.forest_area_sqkm / (l.total_area_sq_mi *
1.609344 ^ 2) * 100 forest_percent
FROM forest_area f JOIN land_area l ON
l.country_code = f.country_code AND l.year = f.year
JOIN regions r ON r.country_name = l.country_name
WHERE l.country_name != 'World' AND l.year = 2016 AND f.forest_area_sqkm /
(l.total_area_sq_mi * 1.609344 ^ 2) * 100 > 75
ORDER BY forest_percent DESC
```

4.RECOMMENDATIONS

```
SELECT l.country_name, region, l.total_area_sq_mi * 1.609344 ^ 2 land,
f.forest_area_sqkm forest, f.forest_area_sqkm / (l.total_area_sq_mi *
1.609344 ^ 2) * 100 forest_percent
FROM forest_area f JOIN land_area l ON
l.country_code = f.country_code AND l.year = f.year
JOIN regions r ON r.country_code = f.country_code
WHERE l.year = 2016
ORDER BY forest_percent
LIMIT 5
```