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 sq km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sq km, a loss of 1324449 sq km ,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 sq km).

2. **REGIONAL OUTLOOK**

In 2016, the percentage of the total land area of the world designated as forest was 31.39%. The region with the highest relative forestation was Europe & Central Asia, with 46.66%, and the region with the lowest relative forestation was Middle East & North Africa, with 2.08% forestation.

In 1990, the percentage of the total land area of the world designated as forest was 32.43%. The region with the highest relative forestation was Latin America & Caribbean, with 49.71%, and the region with the lowest relative forestation was Middle East & North Africa, with 1.79 % forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016:

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51.08	46.14
Sub-Saharan Africa	30.65	28.72
Europe & Central Asia	37.20	38.07
East Asia & Pacific	25.57	26.29
South Asia	16.53	17.50
Middle East & North Africa	1.78	2.07
North America	35.66	35.81

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.08% to 46.14%) and Sub-Saharan Africa(30.65 % to 28.72%). 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 32.41% to 31.37 %.

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 527229.062 sq km. 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 sq km, 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 by 213.664588870028% 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	282193.9844
Myanmar	East Asia & Pacific	107234.0039
Nigeria	Sub-Saharan Africa	106506.00098
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 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 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%	72
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the 2nd 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_name	region	forest_percentage
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

4. RECOMMENDATIONS

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

- *China and the United states have had the highest forestation increase between 1990 and 2016*
- *The most effort to regenerate forestation should be put on the sub_saharan region, especially in Togo, Nigeria, Uganda and Mauritania because these countries saw the largest deforestation percentage.*

5. APPENDIX: SQL Queries Used

FORESTATION TABLE

```
CREATE VIEW forestation AS
SELECT f.country_code,
f.country_name,f.year,f.forest_area_sqkm,l.total_area_sq_mi,r.region,ROUND(
(f.forest_area_sqkm/(l.total_area_sq_mi*2.59)*100)::numeric,2)    AS
forest_percentage
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=l.country_code;
```

GLOBAL SITUATION

1. **Total forest in 1990**

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

2. **Total forest in 2016**

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

3. **Sqkm change in forest area of the world between 1990 and 2016**

```
WITH table1 AS
(SELECT country_name, forest_area_sqkm AS forest_1990
    FROM forest_area
    WHERE country_name='World' AND year=1990),
     table2 AS
        (SELECT country_name, forest_area_sqkm AS forest_2016
         FROM forest_area
          WHERE country_name='World' AND year=2016)

SELECT t1.country_name, (t1.forest_1990-t2.forest_2016) AS
forest_area_change
FROM table1 t1
JOIN table2 t2
ON t1.country_name= t2.country_name
```

4. **Percent change in forest area of the world between 1990 and 2016**

```
WITH table1 AS
(SELECT country_name, forest_area_sqkm AS forest_1990
    FROM forest_area
    WHERE country_name='World' AND year=1990),
     table2 AS
        (SELECT country_name, forest_area_sqkm AS forest_2016
         FROM forest_area
          WHERE country_name='World' AND year=2016)

SELECT
t1.country_name,ROUND((((t2.forest_2016-t1.forest_1990)/t1.forest_199
0)*100)::Numeric,2) AS   forest_area_change
FROM table1 t1
JOIN table2 t2
ON t1.country_name= t2.country_name;
```

5. **Comparing total forest lost between 1990 and 2016 to total land of a country**

```
SELECT country_name, (total_area_sq_mi*2.59) AS land
FROM land_area
WHERE year=2016 AND total_area_sq_mi IS NOT NULL
ORDER BY 2 DESC
```

2. REGIONAL OUTLOOK

percent forest of the entire world in 2016

1.Percentage of total land designated as forest area in 1990

```
WITH table1 AS
     (SELECT f.country_name, f.country_code, f.year, f.forest_area_sqkm,
l.total_area_sq_mi
     FROM forest_area f
     JOIN land_area l
     ON l.country_name=f.country_name
      WHERE f.year=1990 AND f.country_name='World')

SELECT
year,ROUND((forest_area_sqkm/(total_area_sq_mi*2.589)*100)::Numeric,2) as
Percentage
FROM table1
WHERE year=1990
LIMIT 1
```

2. **Region with the highest relative forest in 1990**

```
WITH table1 AS
        (SELECT DISTINCT f.country_name, f.country_code, f.year,
f.forest_area_sqkm,    l.total_area_sq_mi, r.region
FROM forest_area f
JOIN land_area l
ON l.country_name=f.country_name
 JOIN Regions r
ON l.country_name=r.country_name
WHERE f.year=1990)
```

```
    SELECT region,
ROUND(((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100)::numeric,2)
AS Relative_forest
FROM table1
GROUP BY region
ORDER BY relative_forest DESC
```

3. Region with the lowest relative forest in 1990

```
  WITH table1 AS
(SELECT DISTINCT f.country_name, f.country_code, f.year,
f.forest_area_sqkm, l.total_area_sq_mi, r.region
FROM forest_area f
JOIN land_area l
ON l.country_name=f.country_name
 JOIN Regions r
ON l.country_name=r.country_name
WHERE f.year=1990)
SELECT region,
ROUND(((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100)::numeric,2)
AS Relative_forest
FROM table1
GROUP BY region
ORDER BY relative_forest
```

4 .Percentage of total land designated as forest area in 2016

```
WITH table1 AS
    (SELECT f.country_name, f.country_code, f.year, f.forest_area_sqkm,
```

```
l.total_area_sq_mi
     FROM forest_area f
     JOIN land_area l
     ON l.country_name=f.country_name
      WHERE f.year=2016 AND f.country_name='World')

SELECT
year,ROUND((forest_area_sqkm/(total_area_sq_mi*2.589)*100)::Numeric,2) as
Percentage
FROM table1
WHERE year=2016
LIMIT 1
```

5. Region with the highest relative forest in 2016

```
WITH table1 AS
        (SELECT DISTINCT f.country_name, f.country_code, f.year,
f.forest_area_sqkm,    l.total_area_sq_mi, r.region
FROM forest_area f
JOIN land_area l
ON l.country_name=f.country_name
 JOIN Regions r
ON l.country_name=r.country_name
WHERE f.year=2016)

     SELECT region,
ROUND(((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100)::numeric,2)
AS Relative_forest
FROM table1
GROUP BY region
```

ORDER BY relative_forest DESC

6. Region with the lowest relative forest in 2016

```
 WITH first_table AS (
  SELECT r.region,
(SUM(f.forest_area_sqkm)/(SUM(l.total_area_sq_mi*   2.59))*100) AS
relative_forest_1999
  FROM forest_area f
  JOIN land_area l
  ON l.country_name=f.country_name
```

```
  JOIN Regions r
  ON l.country_name=r.country_name
  WHERE f.year=1990
  GROUP BY r.region),
second_table AS (
SELECT r.region, (SUM(f.forest_area_sqkm)/(SUM(l.total_area_sq_mi*
2.59))*100) AS relative_forest_2016
 FROM forest_area f
 JOIN land_area l
 ON l.country_name=f.country_name
 JOIN Regions r
 ON l.country_name=r.country_name
 WHERE f.year=2016
 GROUP BY r.region)
```

Table 2.1

```
WITH t1 AS
(SELECT r.region, (SUM(f.forest_area_sqkm) OVER (PARTITION BY r.region
ORDER BY r.region)) AS forest_area,(SUM(l.total_area_sq_mi*2.59) OVER
(PARTITION BY r.region ORDER BY r.region)) AS land_area
FROM forest_area f
JOIN regions r
ON f.country_name=r.country_name
JOIN land_area l
ON l.country_name=r.country_name
WHERE f.year=2016)

  SELECT DISTINCT region, forest_area, land_area,
ROUND(((forest_area/land_area)*100)::Numeric,2) AS forest_percentage
  FROM t1
  ORDER BY forest_percentage
```

3. **COUNTRY-LEVEL DETAIL**

1. **5 countries with the largest amount decrease in forest area from 1990 to 2016**

```
WITH t1 AS
(SELECT country_name, forest_area_sqkm AS forest_2016
 FROM forest_area
 WHERE year=2016 AND country_name!='World'),
t2 AS
(SELECT country_name, forest_area_sqkm AS forest_1990
 FROM forest_area
 WHERE year=1990 AND country_name!='World')

 SELECT t1.country_name, r.region,(forest_2016-forest_1990) AS
forest_change
 FROM t1
 JOIN t2
 ON t1.country_name=t2.country_name
 JOIN regions r
 ON t2.country_name= r.country_name
 ORDER BY forest_change
```

2. **5 countries saw the largest percent decrease in forest area from 1990 to 2016**

```
 WITH t1 AS
(SELECT f.country_name,r.region, f.forest_area_sqkm as forest_1990
FROM forest_area f
JOIN regions r
ON f.country_name=r.country_name
WHERE f.year=1990),

t2 AS
 (SELECT f.country_name,r.region, f.forest_area_sqkm AS forest_2016
FROM forest_area f
JOIN regions r
ON f.country_name=r.country_name
WHERE f.year=2016)

select
```

```
t1.country_name,t1.region,ROUND(((-(t2.forest_2016-t1.forest_1990)/t1.fores
t_1990)*100)::Numeric,2) AS forest_change
FROM t1
JOIN t2
ON t1.country_name=t2.country_name
WHERE t1.forest_1990>t2.forest_2016
ORDER BY forest_change DESC
LIMIT 5
```

3. QUARTILES

```
WITH forestation AS
(SELECT f.country_code,
f.country_name,f.year,f.forest_area_sqkm,l.total_area_sq_mi,r.region,ROUND(
(f.forest_area_sqkm/(l.total_area_sq_mi*2.59)*100)::numeric,2)    AS
forest_percentage
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=l.country_code)
SELECT distinct(quartiles), COUNT(country_name) OVER (PARTITION BY
quartiles)
FROM
(SELECT country_name,
CASE WHEN forest_percentage <=25 THEN '0-25%'
WHEN forest_percentage<=50 AND forest_percentage>25 THEN '25-50%'
WHEN forest_percentage<=75 AND forest_percentage>50 THEN  '50-75%'
ELSE '75-100%'
END AS quartiles
FROM forestation
WHERE region !='World' AND forest_percentage IS NOT NULL AND
  year=2016) sub
```

Table 3.4

```sql
WITH forestation AS
(SELECT f.country_code,
f.country_name,f.year,f.forest_area_sqkm,l.total_area_sq_mi,r.region,ROUND(
(f.forest_area_sqkm/(l.total_area_sq_mi*2.59)*100)::numeric,2)    AS
forest_percentage
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=l.country_code),
table2 AS
(SELECT
country_code,country_name,year,forest_area_sqkm,total_area_sq_mi,region,
forest_percentage,
 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'
ELSE '75-100' END AS quartile
FROM forestation
WHERE year=2016 AND forest_percentage IS NOT NULL)

 SELECT country_name, region, forest_percentage
 FROM table2
 WHERE quartile='75-100'
 ORDER BY forest_percentage DESC
```