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 3.20%.

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 1279999.98 sqkm).

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 32.21. 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
Sub-Saharan Africa	30.67	28.79
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 33.55% (527229.06 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 2.62% (79200 sqkm), much lower than the figure for India.

India and Russian Federation 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	282193.98
Mynmar	East Asia & Pacific	107234.00
Nigeria	Sub-Saharan Africa	106506.00
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	98
25-50	73
50-75	38
75-100	9

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

4. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.
- *What have you learned from the World Bank data?*

Through this World Bank Data I have learned that the over the years the world forest area has decreased from 1990 to 2016, even though there are many countries which increased in forest area. Even though some countries in the Sub-Saharan Africa region have highest percent of land designated as forest, there are many countries in the same region which has huge amount of decrease in the forest area. It is good to look into this and see what has changed. The same goes with the East Asia & Pacific region as well. Some countries have progress as well as some countries have declined. Middle east & North Africa has a relatively low forestation and it has decreased over the years. This is a pretty big concern. Even though the largest relative forestation id Latin American & Caribbean, it has also decreased over the years which is not a good sign. It will be really helpful to look into the countries which increased their forest area from 1990 to 2016 and see which methods can be implemented to those regions/countries so that forestation can improve. Mainly the awareness has to be created among people.

- *Which countries should we focus on over others?*
Nigeria is one of the country which we have to mainly focus on. But other countries such as Togo, Uganda, Mauritania, Honduras

5. APPENDIX: SQL Queries Used

/* create a view combining all the tables */

DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation AS
SELECT f.country_code AS country_code,
        f.country_name AS country_name,
        f.year AS year,
        f.forest_area_sqkm,
        l.total_area_sq_mi,
        l.total_area_sq_mi * 2.59 AS total_area_sqkm,
        r.region, r.income_group,
        (f.forest_area_sqkm)/(l.total_area_sq_mi*2.59) *100 AS
        forest_per_area_sqkm
  FROM forest_area f
  JOIN land_area l
  ON f.year = l.year AND f.country_code = l.country_code
  JOIN regions r
  ON l.country_code = r.country_code;

/* **1a**. What was the total forest area (in sq km) of the world in 1990? Please keep in mind that you can use the country record denoted as "World" in the region table. */

SELECT forest_area_sqkm AS total_forest_area_world

```
FROM forestation
WHERE year = 1990 AND country_name = 'World';
```

```
SELECT forest_area_sqkm AS total_forest_area_world
FROM forestation
WHERE year = 2016 AND country_name = 'World';
```

```
SELECT
  (SELECT forest_area_sqkm AS total_forest_area_world_1990
    FROM forestation
    WHERE year = 1990  and region = 'World')
     -
  (SELECT forest_area_sqkm AS total_forest_area_world_2016
   FROM forestation
   WHERE year = 2016 and region = 'World');
```

```
WITH areas_2016
AS
(SELECT forest_area_sqkm AS forestarea_2016, year
FROM forestation
WHERE year = 2016  and country_name = 'World'),

areas_1990
AS
(SELECT forest_area_sqkm AS forestarea_1990, year
FROM forestation
WHERE year = 1990 and country_name = 'World'),

difference
AS
(SELECT forestarea_2016, forestarea_1990, forestarea_2016 - forestarea_1990 AS diff,
        (forestarea_2016-forestarea_1990)/forestarea_1990*100 AS diff_percentage
FROM areas_2016, areas_1990)

SELECT forestarea_1990, forestarea_2016, diff, ROUND(diff_percentage ::NUMERIC, 2)
FROM difference;
```

```sql
SELECT DISTINCT country_name, total_area_sqkm
FROM forestation
WHERE total_area_sqkm BETWEEN 1270000 AND 1350000;
```

```sql
SELECT country_name, total_area_sqkm
FROM forestation
WHERE year = 2016 AND total_area_sqkm < 1324449
ORDER BY 2 DESC
LIMIT 1;
```

/* **2a**.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? */

```sql
WITH percent_forest_1990
AS
(SELECT region,(SUM(forest_area_sqkm)*100)/SUM(total_area_sqkm) AS percentage_1990
FROM forestation
WHERE year = 1990
GROUP BY region),

percent_forest_2016
AS
(SELECT region,(SUM(forest_area_sqkm)*100/SUM(total_area_sqkm)) AS percentage_2016
FROM forestation
WHERE year = 2016
GROUP BY region)
```

/*What was the percent forest of the entire world in 2016? */
```sql
SELECT region, ROUND(percentage_2016::NUMERIC,2)
FROM percent_forest_2016
WHERE region = 'World' ;
```

/*Which region had the HIGHEST percent forest in 2016 to 2 decimal places? */
```sql
SELECT region, ROUND(percentage_2016::NUMERIC,2)
FROM percent_forest_2016
ORDER BY percentage_2016 DESC;
```

/*Which region had the LOWEST percent forest in 2016 to 2 decimal places? */
```sql
SELECT region, ROUND(percentage_2016::NUMERIC,2)
FROM percent_forest_2016
ORDER BY percentage_2016;
```

/* 2b.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?*/

```sql
WITH percent_forest_1990
```

```
AS
(SELECT region,(SUM(forest_area_sqkm)*100)/SUM(total_area_sqkm) AS percentage_1990
FROM forestation
WHERE year = 1990
GROUP BY region),

percent_forest_2016
AS
(SELECT region,(SUM(forest_area_sqkm)*100/SUM(total_area_sqkm)) AS percentage_2016
FROM forestation
WHERE year = 2016
GROUP BY region)
```

/*What was the percent forest of the entire world in 1990? */
```
SELECT region, ROUND(percentage_1990::NUMERIC,2)
FROM percent_forest_1990
WHERE region = 'World' ;
```

/*Which region had the HIGHEST percent forest in 1990 to 2 decimal places?*/
```
SELECT region, ROUND(percentage_1990::NUMERIC,2)
FROM percent_forest_1990
ORDER BY percentage_1990 DESC;
```

/*Which region had the LOWEST percent forest in 1990 to 2 decimal places?*/
```
SELECT region, ROUND(percentage_1990::NUMERIC,2)
FROM percent_forest_1990
ORDER BY percentage_1990;
```

/*2c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?*/

```
WITH percent_forest_1990
AS
(SELECT region, ROUND((SUM(forest_area_sqkm)*100/SUM(total_area_sqkm))::NUMERIC,2) AS
        percentage_1990
FROM forestation
WHERE year = 1990
GROUP BY region),

percent_forest_2016
AS
(SELECT region, ROUND((SUM(forest_area_sqkm)*100/SUM(total_area_sqkm))::NUMERIC,2) AS
        percentage_2016
FROM forestation
WHERE year = 2016
GROUP BY region),

joined_1990_2016
AS
```

```
(SELECT percent_forest_1990.region AS region, percentage_1990, percentage_2016
FROM percent_forest_1990
JOIN percent_forest_2016
ON percent_forest_1990.region = percent_forest_2016.region)

SELECT region , percentage_1990, percentage_2016, ROUND((percentage_1990-
        percentage_2016)::NUMERIC,2)  as percent_change
FROM joined_1990_2016
GROUP BY 1,2,3
ORDER BY 4 DESC;
```

/*3a. Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?*/

```
WITH forest_1990
AS
(SELECT country_name, region, forest_area_sqkm AS forest_area_1990
FROM forestation
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL AND country_name!='World'),
forest_2016
AS
(SELECT country_name, region, forest_area_sqkm AS forest_area_2016
FROM forestation
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL AND country_name!='World'),

joined_1990_2016
AS
(SELECT forest_1990.country_name AS country, forest_1990.region AS region_name,
        forest_1990.forest_area_1990, forest_2016.forest_area_2016
FROM forest_1990
JOIN forest_2016
ON forest_1990.country_name = forest_2016.country_name)

SELECT country, region_name, (forest_area_1990 - forest_area_2016) AS decrease_forest,
        ROUND(((forest_area_1990- forest_area_2016)*100/forest_area_1990)::NUMERIC,2) AS
        percent_decrease_forest
FROM joined_1990_2016
ORDER BY 3 DESC;
```

/*3b.Which 5 countries saw the largest percent decrease in forest area from 1990 to 2016? What was the percent change to 2 decimal places for each? */

```
WITH forest_1990
AS
(SELECT country_name, region, forest_area_sqkm AS forest_area_1990
FROM forestation
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL AND country_name!='World'),
forest_2016
AS
```

```
(SELECT country_name, region, forest_area_sqkm AS forest_area_2016
FROM forestation
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL AND country_name!='World'),

joined_1990_2016
AS
(SELECT forest_1990.country_name AS country, forest_1990.region AS region_name,
        forest_1990.forest_area_1990, forest_2016.forest_area_2016
FROM forest_1990
JOIN forest_2016
ON forest_1990.country_name = forest_2016.country_name)

SELECT country, region_name, (forest_area_1990 - forest_area_2016) AS decrease_forest,
       ROUND(((forest_area_1990- forest_area_2016)*100/forest_area_1990)::NUMERIC,2) AS
       percent_decrease_forest
FROM joined_1990_2016
ORDER BY 4 DESC;
```

/*3c.If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016? */

```
WITH quartile
AS
(SELECT country_name, ROUND(forest_per_area_sqkm::NUMERIC,2) AS percent_forest,
 CASE WHEN forest_per_area_sqkm >= 75 THEN '75-100'
      WHEN forest_per_area_sqkm >= 50 THEN '50-75'
      WHEN forest_per_area_sqkm >= 25 THEN '25-50'
      ELSE '0-25' END AS quartile_range
 FROM forestation
 WHERE year = 2016)

 SELECT quartile_range, COUNT(country_name) AS num_countries
 FROM quartile
 GROUP BY quartile_range
 ORDER BY 1;
```

/*3d.List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.*/

```
WITH quartile
AS
(SELECT country_name, region, ROUND(forest_per_area_sqkm::NUMERIC,2) AS percent_forest,
 CASE WHEN forest_per_area_sqkm >= 75 THEN '75-100'
      WHEN forest_per_area_sqkm >= 50 THEN '50-75'
      WHEN forest_per_area_sqkm >= 25 THEN '25-50'
      ELSE '0-25' END AS quartile_range
 FROM forestation
 WHERE year = 2016)

 SELECT country_name, region, percent_forest
```

```
 FROM quartile
 WHERE quartile_range = '75-100'
 ORDER BY 3 DESC;
```

/*3e.How many countries had a percent forestation higher than the United States in 2016?*/

```
WITH quartile
AS
(SELECT country_name, region, ROUND(forest_per_area_sqkm::NUMERIC,2) AS percent_forest,
 CASE WHEN forest_per_area_sqkm >= 75 THEN '75-100'
         WHEN forest_per_area_sqkm >= 50 THEN '50-75'
         WHEN forest_per_area_sqkm >= 25 THEN '25-50'
         ELSE '0-25' END AS quartile_range
 FROM forestation
 WHERE year = 2016)

 SELECT  COUNT(country_name) AS num_countries
 FROM quartile
 WHERE percent_forest > 33.93;
```