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 3.21%.

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 1279999.99 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 32.42. 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

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 527229.06 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 79200 sqkm, 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 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
Myanmar	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 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%	73
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the first (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

94 countries had a percent forestation higher than the United States in 2016

4. 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?*

There has been reduction of global forest between 1990 and 2016 with particularly alarming situation in Sub-Saharan Africa. 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. 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.

5. Appendix: SQL queries used

```
CREATE VIEW forestation AS SELECT
fa.country_code code,
fa.country_name country,
fa.year "year",
fa.forest_area_sqkm forest_area_sqkm,
la.total_area_sq_mi total_area_sq_mi,
re.region region,
re.income_group income_group,
(100*fa.forest_area_sqkm)/(la.total_area_sq_mi*2.59) AS percent_forest
FROM forest_area fa
JOIN land_area la
ON fa.country_code = la.country_code AND fa.year = la.year
JOIN regions re
ON re.country_code=fa.country_code;
```

GLOBAL SITUATION:

a. 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
FROM forestation
WHERE year=1990 and region='World';
```

b. What was the total forest area (in sq km) of the world in 2016? Please keep in mind that you can use the country record in the table is denoted as “World.”

```
SELECT forest_area_sqkm
FROM forestation
WHERE year=2016 and region='World';
```

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
SELECT f1.forest_area_sqkm -f2.forest_area_sqkm AS forest_area_change
FROM forestation f1, forestation f2
WHERE f1.year = 1990
AND f1.region='World'
AND f2.year = 2016
AND f2.region = 'World';
```

d. What was the percent change in forest area of the world between 1990 and 2016?

```
SELECT (f1.forest_area_sqkm -f2.forest_area_sqkm)*100/f1.forest_area_sqkm AS
forest_area_pct_change
FROM forestation f1, forestation f2
WHERE f1.year = 1990
AND f1.region='World'
AND f2.year = 2016
AND f2.region = 'World';
```

e. If you compare the amount of forest area lost between 1990 and 2016, to which country's total area in 2016 is it closest to?

```
WITH T1 AS
(SELECT f1.forest_area_sqkm -f2.forest_area_sqkm AS forest_area_change
FROM forestation f1, forestation f2
WHERE f1.year = 1990
AND f1.region='World'
AND f2.year = 2016
AND f2.region = 'World')

SELECT country,T1.forest_area_change-total_area_sq_mi*2.59 AS delta
FROM forestation, T1
WHERE year = 2016 AND total_area_sq_mi*2.59<T1.forest_area_change
ORDER BY 2
LIMIT 1
```

REGIONAL OUTLOOK:

a. 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?
&

b. 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?

&

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

```
SELECT year,percent_forest
FROM forestation
WHERE year=2016
AND region='World';
SELECT year,percent_forest
FROM forestation
WHERE year=1990
AND region='World';

SELECT region,
      ROUND(CAST((region_forest_1990/ region_total_1990)*100
      AS NUMERIC),2) AS forest_percent_1990,
      ROUND(CAST((region_forest_2016 / region_total_2016)*100
      AS NUMERIC),2) AS forest_percent_2016
FROM (SELECT SUM(f1.forest_area_sqkm) region_forest_1990,
           SUM(f1.total_area_sq_mi*2.59) region_total_1990,f1.region,
           SUM(f2.forest_area_sqkm) region_forest_2016,
           SUM(f2.total_area_sq_mi*2.59)  region_total_2016
     FROM  forestation f1, forestation f2
     WHERE  f1.year = '1990' AND f1.country != 'World'
           AND f2.year = '2016' AND f2.country != 'World'
           AND f1.region = f2.region
     GROUP  BY f1.region) region_forest_percent
ORDER  BY 2 DESC;
```

COUNTRY-LEVEL DETAIL:

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

```
SELECT f2.country, f2.region,
  f2.forest_area_sqkm - f1.forest_area_sqkm AS difference
FROM forestation f2
JOIN forestation f1
  ON  (f2.year = '2016' AND f1.year = '1990')
  AND f2.country = f1.country
WHERE f2.forest_area_sqkm IS NOT NULL AND f1.forest_area_sqkm IS NOT NULL AND
f1.country!='World'
ORDER BY difference
LIMIT 5;
```

b. 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?

```
SELECT f2.country,f2.region,
  100*(f2.forest_area_sqkm - f1.forest_area_sqkm)/f1.forest_area_sqkm AS pct_difference
FROM forestation f2
JOIN forestation f1
  ON  (f2.year = '2016' AND f1.year = '1990')
  AND f2.country = f1.country
WHERE f2.forest_area_sqkm IS NOT NULL AND f1.forest_area_sqkm IS NOT NULL AND
f1.country!='World'
ORDER BY pct_difference DESC
LIMIT 5;
```

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

```
SELECT distinct(quartiles), COUNT(country) OVER (PARTITION BY quartiles)
FROM (SELECT country,
  CASE WHEN percent_forest <= 25 THEN '0-25%'
  WHEN percent_forest <= 75 AND percent_forest > 50 THEN '50-75%'
  WHEN percent_forest <= 50 AND percent_forest > 25 THEN '25-50%'
  ELSE '75-100%'
END AS quartiles FROM forestation
WHERE percent_forest IS NOT NULL AND year = 2016) quart;
```

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

```
SELECT country,region,percent_forest
FROM forestation
WHERE percent_forest > 75 AND year = 2016
ORDER BY 3 DESC;
```

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

```
SELECT COUNT(country)
FROM forestation
WHERE year=2016 AND percent_forest>
    (SELECT percent_forest
     FROM forestation
     WHERE country='United States' AND year=2016);
```