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 41,282,694.9 square kilometers in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 square kilometers, a loss of 1324449 square kilometers, 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 square kilometers).

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 527229.1 square 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 square km, much lower than the figure for China.

China and The U.S. 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	541,510 square km
Indonesia	East Asia & Pacific	282,193.98 square km
Myanmar	East Asia & Pacific	107,243 square km
Nigeria	Sub-Saharan Africa	106,506 square km
Tanzania	Sub-Saharan Africa	102,320 square km

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
1	85
2	73
3	38
4	9

***NOTE**: These numbers reflect the removal of null values for forestation percent. If we include null values, Then the 1st quartile will have 98 values instead of 85

The largest number of countries in 2016 were found in the 1st quartile.

There were 51 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

***Note:** I could not find a place to put the answer to "How many countries have a higher forestation % than the United States in 2016," so I'll put it here:

There were 94 countries that have a higher forestation % than the United States in 2016 (See Appendix for SQL query)

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?*

The ForestQuery team has learned from the World Bank data that there is work to be done. While the amount of forestation/forestation percentages of countries varied between 1990 and 2016, the overall forestation numbers for the World have decreased, which is problematic. Specifically, Sub-Saharan Africa has a number of countries that are losing forest area at a concerning rate.

To combat this problem, we suggest a two-pronged approach: First, organizations like the United Nations can work with or encourage local countries' governments in countries where forestation is decreasing to identify the root causes of deforestation in their countries. Once the causes have been identified, suggest legislation that these countries can implement to dampen or remove the effects of these causes.

Next, we look at countries that have high forestation/forestation percentage increases. For the latter metric, we can discuss with those countries (Iceland, etc.) the motivations and methods as to how they achieved these metrics. For countries with higher absolute forestation increases (China, United States, etc.), we can discuss how they implemented a healthy forestation policy at large-scale. With this information we can craft sustainable policy for countries that are suffering from deforestation that can be implemented at-scale.

We at the ForestQuery team strongly urge leaders to take immediate action to combat the deforestation of our World, so that we can live in a better future together.

5. APPENDIX

A. “Forestation” View

```
CREATE VIEW forestation AS SELECT fa.country_code,
                fa.country_name,
                fa.year,
                fa.forest_area_sqkm,
                la.total_area_sq_mi,
                r.region,
                r.income_group,
                2.59 * la.total_area_sq_mi AS total_area_sqkm,
                (fa.forest_area_sqkm / (2.59 * la.total_area_sq_mi)) * 100 AS for_pct_of_land
        FROM forest_area fa
        JOIN land_area la
        ON fa.country_code = la.country_code AND fa.year = la.year
        JOIN regions r
        ON r.country_code = fa.country_code
```

For readability of queries, we will use the first option, as it won’t make much difference when we query to find our answers moving forward.

B. Global Situation

a. First Query:

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

b. Second Query:

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

c. Third Query:

```
SELECT area_1990 - area_2016 AS area_diff
FROM (SELECT country_name, forest_area_sqkm AS area_1990
        FROM forestation
```

```
        WHERE country_name = 'World' AND year = 1990) t1
JOIN (SELECT country_name, forest_area_sqkm AS area_2016
        FROM forestation
        WHERE country_name = 'World' AND year = 2016) t2
ON t1.country_name = t2.country_name;
```

d. Fourth Query:

```
SELECT (1 - (area_2016 / area_1990)) * 100 AS pct_loss
FROM (SELECT country_name, forest_area_sqkm AS area_1990
        FROM forestation
        WHERE country_name = 'World' AND year = 1990) t1
JOIN (SELECT country_name, forest_area_sqkm AS area_2016
        FROM forestation
        WHERE country_name = 'World' AND year = 2016) t2
ON t1.country_name = t2.country_name;
```

e. Fifth Query:

```
SELECT country_name, 2.59 * total_area_sq_mi AS total_area_sqkm
FROM forestation
WHERE 2.59 * total_area_sq_mi <
        (SELECT area_1990 - area_2016 AS area_diff
        FROM (SELECT country_name, forest_area_sqkm AS area_1990
                FROM forestation
                WHERE country_name = 'World' AND year = 1990) t1
        JOIN (SELECT country_name, forest_area_sqkm AS area_2016
                FROM forestation
                WHERE country_name = 'World' AND year = 2016) t2
        ON t1.country_name = t2.country_name)
AND year = 2016
ORDER BY 2 DESC
LIMIT 1;
```

C. Regional Outlook

a. First Query (Regional table):

```
SELECT t1.region,
        ROUND(CAST(forest_pct_1990 AS numeric) , 2) AS forest_pct_1990,
        ROUND(CAST(forest_pct_2016 AS numeric), 2) AS forest_pct_2016
```

```
FROM ( SELECT region,
        100 * (SUM(forest_area_sqkm) / SUM(total_area_sqkm)) AS forest_pct_2016
        FROM forestation
        WHERE year = 2016
        GROUP BY 1) t1
JOIN (SELECT region,
        100 * (SUM(forest_area_sqkm) / SUM(total_area_sqkm)) AS forest_pct_1990
        FROM forestation
        WHERE year = 1990
        GROUP BY 1) t2
ON t1.region = t2.region
ORDER BY 2 DESC;
```

We can use inspection on the table created by this query to answer all the questions in this section. If we wish to organize the values in our two numeric columns from lowest to highest values, then simply remove “DESC” from the end of the last line and run the resulting query.

D. Country-Level Detail

a. First Query (Top 5 Decrease):

```
SELECT t1.country_name, t1.region, forest_area_2016 - forest_area_1990 AS area_diff
FROM (SELECT country_name, region, forest_area_sqkm AS forest_area_1990
        FROM forestation
        WHERE year = 1990) t1
JOIN (SELECT country_name, region, forest_area_sqkm AS forest_area_2016
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name AND t1.region = t2.region
WHERE t1.country_name <> 'World'
ORDER BY 3
LIMIT 5;
```

b. Second Query (Top 5 Increase):

```
SELECT t1.country_name, t1.region, forest_area_2016 - forest_area_1990 AS area_diff
FROM (SELECT country_name, region, forest_area_sqkm AS forest_area_1990
        FROM forestation
        WHERE year = 1990) t1
JOIN (SELECT country_name, region, forest_area_sqkm AS forest_area_2016
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name AND t1.region = t2.region
WHERE t1.country_name <> 'World' AND forest_area_2016 - forest_area_1990 IS NOT
NULL
```

```
ORDER BY 3 DESC
LIMIT 5;
```

c. Third Query (Top 5 Percent Decrease):

```
SELECT t1.country_name, t1.region,
ROUND(CAST(100 * ((forest_area_2016 - forest_area_1990)/forest_area_1990) AS
numeric), 2) AS forest_pct_diff
FROM (SELECT country_name, region, forest_area_sqkm AS forest_area_1990
        FROM forestation
        WHERE year = 1990) t1
JOIN (SELECT country_name, region, forest_area_sqkm AS forest_area_2016
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name AND t1.region = t2.region
WHERE t1.country_name <> 'World'
ORDER BY 3
LIMIT 5;
```

d. Fourth Query (Top 5 Percent Increase):

```
SELECT t1.country_name, t1.region,
ROUND(CAST(100 * ((forest_area_2016 - forest_area_1990)/forest_area_1990) AS
numeric), 2) AS forest_pct_diff
FROM (SELECT country_name, region, forest_area_sqkm AS forest_area_1990
        FROM forestation
        WHERE year = 1990) t1
JOIN (SELECT country_name, region, forest_area_sqkm AS forest_area_2016
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name AND t1.region = t2.region
WHERE t1.country_name <> 'World' AND ((forest_area_2016 -
forest_area_1990)/forest_area_1990) IS NOT NULL
ORDER BY 3 DESC
LIMIT 5;
```

e. Fifth Query (Quartile GROUPS):

```
SELECT for_pct_quartiles, COUNT(for_pct_quartiles)
FROM(SELECT country_name, region, for_pct_of_land,
        CASE
                WHEN for_pct_of_land > 75 THEN 4
```

```
                WHEN 75 >= for_pct_of_land AND for_pct_of_land > 50 THEN 3
                WHEN 50 >= for_pct_of_land AND for_pct_of_land > 25 THEN 2
                ELSE 1
        END AS for_pct_quartiles
        FROM forestation
        WHERE year = 2016 AND for_pct_of_land IS NOT NULL) t1
GROUP BY 1
ORDER BY 2 DESC;
```

f. Sixth Query (4th Quartile countries)

```
SELECT country_name, region, ROUND(CAST(for_pct_of_land AS numeric), 2)
FROM(SELECT country_name, region, for_pct_of_land,
        CASE
                WHEN for_pct_of_land > 75 THEN 4
                WHEN 75 >= for_pct_of_land AND for_pct_of_land > 50 THEN 3
                WHEN 50 >= for_pct_of_land AND for_pct_of_land > 25 THEN 2
                ELSE 1
        END AS for_pct_quartiles
        FROM forestation
        WHERE year = 2016 AND for_pct_of_land IS NOT NULL) t1
WHERE for_pct_quartiles = 4
ORDER BY 3 DESC;
```

g. Seventh Query (% Forestation > United States)

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