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 km^2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 km^2, a loss of 1,324,449 km^2, or 3.2% decrease.

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 1,279,999.98 km^2).

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 and 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 and the Caribbean, with 51.03%, and the region with the lowest relative forestation was Middle East and 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%
World	32.42%	31.38%
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 527,229.06 km^2. 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, much lower than the figure for China.

China and 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	541,510 km^2
Indonesia	East Asia & Pacific	282,193.98 km^2
Myanmar	East Asia & Pacific	107,232 km^2
Nigeria	Sub-Saharan Africa	106506 km^2
Tanzania	Sub-Saharan Africa	102,320km^2

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	61.8%
Uganda	Sub-Saharan Africa	59.27%
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 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	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	87.5
Guyana	Latin America & Caribbean	83.9
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?*
- *Which countries should we focus on over others?*

The results show than regions in the World are increasing in forest area and I have learnt the World has lost 3.20% of forest designated area from 1990 to 2016. The forest area percentage

lost is more than the land of Peru. A huge amount of decrease in forest area in Latin America & Caribbean and Sub-Saharan Africa so we should focus on afforestation for these countries more. Brazil has the largest absolute forest area change followed by Indonesia, Myanmar and Nigeria.

Lastly, we can partner with China, US to find more better approach for increasing forest area because they perform well in increasing forest area.

5. APPENDIX: SQL Queries Used

--Create a Forestation VIEW--

```
DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation
AS
(Select f.country_code , f.country_name , f.year, f.forest_area_sqkm,
                              l.total_area_sq_mi,
r.region,r.income_group,f.forest_area_sqkm/ (l.total_area_sq_mi*2.59)*100 as
forest_percentage, l.total_area_sq_mi*2.59 total_area_sqkm
   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 = f.country_code);
```

-- 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, year
FROM forestation
WHERE country_name = 'World' and
        year = 1990
```

forest_area_sqkm	year
41282694.9	1990

-- b.Area in 2016

```
                    SELECT forest_area_sqkm, year
```

FROM forestation
WHERE country_name = 'World' and
                year =2016

                39958245.9   2016
 --Change in forest_area from 1990 to 2016

    SELECT new.forest_area_sqkm - old.forest_area_sqkm
    FROM forest_area AS new
    JOIN forest_area AS old
     ON (new.year= '2016' AND old.year = '1990'
     AND new.country_name = 'World' AND old.country_name = 'World');
  -1324449

  --Percentage change
     SELECT 100.0*(new.forest_area_sqkm - old.forest_area_sqkm) /old.forest_area_sqkm AS
percentage
   FROM forest_area AS new
    JOIN forest_area AS old
     ON (new.year= '2016' AND old.year = '1990'
     AND new.country_name = 'World' AND old.country_name = 'World');

     -3.20824258980244

 E. --compare the amount of forest area lost between 1990 and 2016, to which country's total
area in 2016 is it closest to

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

    Peru   1279999.9891
--REGIONAL OUTLOOK
--2a
SELECT country_name,
round(((sum(forest_area_sqkm)/sum(total_area_sq_mi*2.59))*100)::NUMERIC, 2) AS
percent_forest
FROM forestation
WHERE year = '2016'
    AND country_name = 'World'
GROUP BY country_name;

--World 31.38

--2bWhat 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?
SELECT region,
ROUND(((Sum(forest_area_sqkm)/sum(total_area_sq_mi*2.59))*100)::Numeric, 2) as percent_forest
FROM forestation
WHERE year ='2016'
Group BY region
ORDER BY percent_forest desc;

/*Latin America & Caribbean 46.16
Europe & Central Asia   38.04
North America   36.04
World   31.38
Sub-Saharan Africa 28.79
East Asia & Pacific 26.36
South Asia 17.51
Middle East & North Africa 2.07*/

--2cBased on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?
SELECT region,
 Round(((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS percent_forest
FROM forestation
WHERE YEAR = '2016'
GROUP BY region
ORDER BY percent_forest desc

region percent_forest
Latin America & Caribbean   46.16
Europe & Central Asia   38.04
North America   36.04
World   31.38
Sub-Saharan Africa 28.79
East Asia & Pacific 26.36
South Asia 17.51
Middle East & North Africa 2.07

--table for 1990
SELECT region,Round(((Sum(forest_area_sqkm) /
Sum(total_area_sq_mi*2.59))*100)::Numeric, 2) AS

```
percent_forest
FROM forestation
WHERE YEAR = '1990'
GROUP BY region
ORDER BY percent_forest desc
Latin America & Caribbean   51.03
Europe & Central Asia   37.28
North America   35.65
World   32.42
Sub-Saharan Africa  30.67
East Asia & Pacific 25.78
South Asia  16.51
Middle East & North Africa  1.78


--2c.1 World
SELECT country_name,
 Round(((Sum(forest_area_sqkm) / Sum(total_area_sq_mi*2.59))*100)::Numeric,2) AS
percent_forest
FROM Forestation
WHERE YEAR = 1990
 AND country_name = 'World'
GROUP BY country_name
country_name    percent_forest
World   32.42

--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?
WITH T1990 as
(SELECT country_name, SUM(forest_area_sqkm)forest_area_1
 From forestation
 WHERE year = 1990
 Group BY country_name, forest_area_sqkm),
 T2016 AS
 (SELECT country_name, SUM(forest_area_sqkm)forest_area_2
  FROM forestation
  WHERE year = 2016
  GROUP BY country_name, forest_area_sqkm)
  SELECT T1990.country_name,
     (T1990.forest_area_1- T2016.forest_area_2)forest_change
    FROM T1990
    JOIN T2016 ON T1990.country_name=T2016.country_name
    ORDER BY forest_change
    LIMIT 5
```

```
country_name forest_change
China   -527229.062
United States  -79200
India    -69213.9844
Russian Federation    -59395
Vietnam         -55390
```

--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 t1990 AS (SELECT f.country_code,
                f.country_name,
                f.year,
                f.forest_area_sqkm
                    FROM forest_area f
            WHERE f.year = 1990 AND f.forest_area_sqkm IS NOT NULL AND
f.country_name != 'World'
            ),

    t2016 AS (SELECT f.country_code,
                f.country_name,
                f.year,
                f.forest_area_sqkm
                    FROM forest_area f
            WHERE f.year = 2016 AND f.forest_area_sqkm IS NOT NULL AND
f.country_name != 'World'
            )


 SELECT t1990.country_code,
     t1990.country_name,
     r.region,
     t1990.forest_area_sqkm AS fa_1990_sqkm,
     t2016.forest_area_sqkm AS fa_2016_sqkm,
     t1990.forest_area_sqkm-t2016.forest_area_sqkm AS difference_fa_sqkm,
     ABS(ROUND(CAST(((t2016.forest_area_sqkm-
t1990.forest_area_sqkm)/t1990.forest_area_sqkm*100) AS NUMERIC),2)) AS perc_change
    FROM t1990
    JOIN t2016
    ON t1990.country_code = t2016.country_code
    AND (t1990.forest_area_sqkm IS NOT NULL AND t2016.forest_area_sqkm IS NOT NULL)
JOIN regions r ON t2016.country_code = r.country_code
    ORDER BY ROUND(CAST(((t2016.forest_area_sqkm-
t1990.forest_area_sqkm)/t1990.forest_area_sqkm*100) AS NUMERIC),2)
```

```
     LIMIT 5;
country_code  country_name region  fa_1990_sqkm           fa_2016_sqkm
        difference_fa_sqkm    perc_change
TGO   Togo   Sub-Saharan Africa   6850   1681.999969  5168.000031  75.45
NGA   Nigeria Sub-Saharan Africa   172340           65833.99902  106506.00098 61.80
UGA   Uganda        Sub-Saharan Africa   47510  19418.00049  28091.99951  59.13
MRT   Mauritania     Sub-Saharan Africa   4150   2210   1940   46.75
HND   Honduras      Latin America & Caribbean    81360  44720  36640  45.03
```

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

```
With t1 AS (SELECT f.country_code,
               f.country_name,
               f.year,
               f.forest_area_sqkm,
               l.total_area_sq_mi*2.59 AS total_area_sqkm,
               (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS percent_fa
               FROM forest_area f
               JOIN land_area l
               ON f.country_code = l.country_code
               AND (f.country_name != 'World' AND f.forest_area_sqkm IS NOT NULL AND
l.total_area_sq_mi IS NOT NULL)
               AND (f.year=2016 AND l.year = 2016)
               ORDER BY 6 DESC
           ),
     t2 AS (SELECT t1.country_code,
               t1.country_name,
               t1.year,
               t1.percent_fa,
               CASE WHEN t1.percent_fa >= 75 THEN 4
                  WHEN t1.percent_fa < 75 AND t1.percent_fa >= 50 THEN 3
                  WHEN t1.percent_fa < 50 AND t1.percent_fa >=25 THEN 2
                  ELSE 1
               END AS percentile
               FROM t1 ORDER BY 5 DESC
           )

SELECT t2.percentile,
     COUNT(t2.percentile)
     FROM t2
     GROUP BY 1
     ORDER BY 2 DESC;

     percentile count
```

```
1       85
2       72
3       38
4       9
```

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

```sql
With t1 AS (SELECT f.country_code,
                f.country_name,
                f.year,
                f.forest_area_sqkm,
                l.total_area_sq_mi*2.59 AS total_area_sqkm,
                (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS percent_fa
                FROM forest_area f
                JOIN land_area l
                ON f.country_code = l.country_code
                AND (f.country_name != 'World' AND f.forest_area_sqkm IS NOT NULL AND
l.total_area_sq_mi IS NOT NULL)
                AND (f.year=2016 AND l.year = 2016)
                ORDER BY 6 DESC
            ),
    t2 AS (SELECT t1.country_code,
                t1.country_name,
                t1.year,
                t1.percent_fa,
                CASE WHEN t1.percent_fa >= 75 THEN 4
                    WHEN t1.percent_fa < 75 AND t1.percent_fa >= 50 THEN 3
                    WHEN t1.percent_fa < 50 AND t1.percent_fa >=25 THEN 2
                    ELSE 1
                END AS percentile
                FROM t1 ORDER BY 5 DESC
            )
SELECT t2.country_name,
    r.region,
    ROUND(CAST(t2.percent_fa AS NUMERIC),2) AS percent_fa,
    t2.percentile
    FROM t2
    JOIN regions r
    ON t2.country_code = r.country_code
    WHERE t2.percentile = 4
    ORDER BY 3 desc;
```

country_name	region	percent_fa	percentile
American Samoa	East Asia & Pacific	87.50	4
Gabon	Sub-Saharan Africa	90.04	4
Guyana	Latin America & Caribbean	83.90	4
Lao PDR	East Asia & Pacific	82.11	4

Micronesia, Fed. Sts. East Asia & Pacific   91.86   4
Palau   East Asia & Pacific   87.61   4
Seychelles   Sub-Saharan Africa   88.41   4
Solomon Islands   East Asia & Pacific   77.86   4
Suriname   Latin America & Caribbean   98.26   4

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

With t1 AS (SELECT f.country_code,
                f.country_name,
                f.year,
                f.forest_area_sqkm,
                l.total_area_sq_mi*2.59 AS total_area_sqkm,
                 (f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS percent_fa
                 FROM forest_area f
                 JOIN land_area l
                 ON f.country_code = l.country_code
                 AND (f.country_name != 'World' AND f.forest_area_sqkm IS NOT NULL AND
l.total_area_sq_mi IS NOT NULL)
                 AND (f.year=2016 AND l.year = 2016)
                 ORDER BY 6 DESC
)
SELECT COUNT(t1.country_name)
    FROM t1
    WHERE t1.percent_fa > (SELECT t1.percent_fa
                    FROM t1
                    WHERE t1.country_name = 'United States'
)
94