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 km^2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km^2, a loss of 1324449 km^2 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 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 & 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
World	32.42	31.38
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 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 79200 km^2, 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 214% 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 5 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	282194
Myanmar	East Asia & Pacific	107234
Nigeria	Sub-Saharan Africa	106506
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	59.27
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
Q4. No of Countries forested 100 - 75 %	9
Q3. No of Countries forested 50 - 75 %	38
Q2. No of Countries forested 25 - 50 %	72
Q1. No of Countries forested 0 - 25 %	85

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

On a global level our data shows a loss of 1324449 km^2 or 3.21% of the land occupied by forests. Lost forest footage was of the size larger than total size of Peru. Digging deeper on regional level we can see that 5 out of 7 regions increased in size. With Latin America & Caribbean region having the biggest drop. Yet it is difficult to make conclusions and gauge where we face potential issues on this level. The difference in change between the regions is not that significant as changes in larger countries could sway the percentage either way. Having said that, I would to recommend looking into success or cause for the concern on a country level. As we learned Iceland increases it's forested area by 214% but this would not make much impact on a global level (Iceland is only 100250 km^2 in size). Hence to make to best impact on a global level I would recommend learning the success from the countries that had the largest percentage increase in forested areas and also comparatively larger countries with largest changes in their forestation levels. The likes China (total land size 9388210 km^2 forest percentage change +34%) and Brazil (total land size 8358140 km^2 forest percentage change -10%). And starting from implementing changes in those larger countries first to improve the forestation levels quicker.

5. APPENDIX: SQL Queries Used

THE VIEW

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
  (SELECT re.region,
          fa.country_code             c_code_fa,
          la.country_code             c_code_la,
          re.country_code             c_code_re,
          fa.country_name              c_name_fa,
          la.country_name              c_name_la,
          re.country_name              c_name_re,
          fa.year                    year_fa,
          la.year                    year_la,
          fa.forest_area_sqkm,
          la.total_area_sq_mi * 2.59              total_area_sqkm,
          fa.forest_area_sqkm / ( la.total_area_sq_mi * 2.59 ) * 100
          forested_pct,
          re.income_group
   FROM   forest_area fa
          JOIN land_area la
```

```
          ON fa.country_code = la.country_code
            AND fa.year = la.year
         JOIN regions re
          ON fa.country_code = re.country_code);
```

1. GLOBAL SITUATION

a

```
SELECT forest_area_sqkm AS total_forest_area_1990
FROM   forestation
WHERE  c_name_re = 'World'
       AND year_fa = 1990;
```

b

```
SELECT forest_area_sqkm AS total_forest_area_2016
FROM   forestation
WHERE  c_name_re = 'World'
       AND year_fa = 2016;
```

c

```
SELECT forest_area_sqkm - (SELECT forest_area_sqkm AS total_forest_area
                           FROM   forestation
                           WHERE  c_name_re = 'World'
                                  AND year_fa = 1990) worlds_forest_change
FROM   forestation
WHERE  c_name_re = 'World'
       AND year_fa = 2016;
```

d

```
WITH worlds_forest_2016
     AS (SELECT c_name_re        locality,
                forest_area_sqkm AS total_forest_area_2016
         FROM   forestation
         WHERE  c_name_re = 'World'
                AND year_fa = 2016),
     worlds_forest_1990
     AS (SELECT c_name_re        locality,
                forest_area_sqkm AS total_forest_area_1990
         FROM   forestation
         WHERE  c_name_re = 'World'
                AND year_fa = 1990)
```

```
SELECT (total_forest_area_2016 - total_forest_area_1990) / total_forest_area_1990 * 100 AS
worlds_forest_change_pct
FROM   worlds_forest_2016 fa2016
       JOIN worlds_forest_1990 fa1990
         ON fa2016.locality = fa1990.locality;
```

e

```
SELECT DISTINCT c_name_la,
                total_area_sqkm
FROM   forestation
WHERE  total_area_sqkm < (SELECT (SELECT forest_area_sqkm AS total_forest_area
                                  FROM   forestation
                                  WHERE  c_name_re = 'World'
                                         AND year_fa = 1990) - forest_area_sqkm
                          FROM   forestation
                          WHERE  c_name_re = 'World'
                                 AND year_fa = 2016)
ORDER  BY 2 DESC
LIMIT  1;
```

2. REGIONAL OUTLOOK

table with all the values required

```
WITH forested_percent_1990
    AS (SELECT region,
               Round(( SUM(forest_area_sqkm) / SUM(total_area_sqkm) * 100 ) ::
                    NUMERIC,
               2) AS
               forested_pct_1990
        FROM   forestation
        WHERE  year_la = 1990
        GROUP  BY 1),
    forested_percent_2016
    AS (SELECT region,
               Round(( SUM(forest_area_sqkm) / SUM(total_area_sqkm) * 100 ) ::
                    NUMERIC,
               2) AS
               forested_pct_2016
        FROM   forestation
        WHERE  year_la = 2016
        GROUP  BY 1),
    forested_percent_both
```

```
    AS (SELECT fp1990.region,
               forested_pct_1990,
               forested_pct_2016
        FROM   forested_percent_1990 fp1990
               join forested_percent_2016 fp2016
                 ON fp1990.region = fp2016.region)
SELECT *
FROM   forested_percent_both
ORDER  BY 2 DESC;
```

3. COUNTRY-LEVEL DETAIL

Success absolute

```
WITH f2016
    AS (SELECT c_name_fa        cn2016,
               forest_area_sqkm forest2016,
               region,
               year_la          y2016
        FROM   forestation
        WHERE  year_fa = 2016),
    f1990
    AS (SELECT c_name_fa        cn1990,
               forest_area_sqkm forest1990,
               year_la          y1990
        FROM   forestation
        WHERE  year_fa = 1990)
SELECT cn2016 country,
       y2016,
       region,
       Round(( forest2016 - forest1990 ) :: NUMERIC) change_of_forest_sqkm
FROM   f2016 a
       join f1990 b
         ON a.cn2016 = b.cn1990
WHERE  ( forest2016 - forest1990 ) IS NOT NULL
       AND cn2016 <> 'World'
ORDER  BY 4 DESC;
```

Success forested_pct

```
WITH f2016
    AS (SELECT c_name_fa        cn2016,
               forest_area_sqkm forest2016,
```

```
            region,
            year_la         y2016
      FROM   forestation
      WHERE  year_fa = 2016),
   f1990
   AS (SELECT c_name_fa       cn1990,
            forest_area_sqkm forest1990,
            year_la         y1990
      FROM   forestation
      WHERE  year_fa = 1990)
SELECT cn2016 country,
      y2016,
      region,
      Round(( ( forest2016 - forest1990 ) / forest1990 * 100 ) :: NUMERIC)
           change_of_forest_pct
FROM   f2016 a
      join f1990 b
        ON a.cn2016 = b.cn1990
WHERE  ( forest2016 - forest1990 ) IS NOT NULL
      AND cn2016 <> 'World'
ORDER  BY 4 DESC;
```

--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 f2016 AS
(
      SELECT c_name_fa       cn2016,
            forest_area_sqkm forest2016,
            region,
            year_la         y2016
      FROM   forestation
      WHERE  year_fa = 2016),
   f1990 AS
(
      SELECT c_name_fa       cn1990,
            forest_area_sqkm forest1990,
            year_la         y1990
      FROM   forestation
      WHERE  year_fa = 1990)
SELECT   cn2016,
        y2016,
        region,
```

```
        ROUND((forest2016 - forest1990)::numeric) lost_forest
FROM     f2016 a
JOIN     f1990 b
ON       a.cn2016 = b.cn1990
WHERE    (
                forest2016 - forest1990) < 0
AND      cn2016 <> 'World'
ORDER BY 4
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?

```
WITH f2016 AS
(
      SELECT c_name_fa        cn2016,
            region,
            forested_pct forest2016pct,
            year_la          y2016
      FROM   forestation
      WHERE  year_fa = 2016 AND forested_pct IS NOT NULL AND c_name_fa <> 'World'),
f1990 AS
(
      SELECT c_name_fa        cn1990,
            forested_pct forest1990pct,
            year_la          y1990
      FROM   forestation
      WHERE  year_fa = 1990 AND forested_pct IS NOT NULL AND c_name_fa <> 'World')
SELECT   cn2016,
         y2016,
         region,
         ROUND(((forest2016pct - forest1990pct) / forest1990pct * 100)::numeric, 2)
lost_forest_pct
FROM     f2016 a
JOIN     f1990 b
ON       a.cn2016 = b.cn1990
WHERE    (
                forest2016pct - forest1990pct) < 0
ORDER BY 4
LIMIT 5;
```

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

```
SELECT CASE
        WHEN forested_pct > 75 THEN 'No of Countries forested 100 - 75 %'
        WHEN forested_pct > 50 THEN 'No of Countries forested 50 - 75 %'
        WHEN forested_pct > 25THEN 'No of Countries forested 25 - 50 %'
        ELSE 'No of Countries forested 0 - 25 %'
       END quartiles,
       Count(*)
FROM   forestation
WHERE  year_fa = 2016
       AND c_name_fa <> 'World'
       AND forested_pct IS NOT NULL
GROUP  BY 1;
```

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

```
SELECT         c_name_fa AS Countries_forested_over_75_pct,
                   region,
       ROUND ((forested_pct)::numeric, 2)
FROM   forestation
WHERE  year_fa = 2016
       AND c_name_fa <> 'World'
       AND forested_pct > 75
ORDER BY 3 DESC;
```

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

```
SELECT Count(*)
FROM   forestation
WHERE  year_fa = 2016
       AND c_name_fa <> 'World'
       AND forested_pct > (SELECT forested_pct
                           FROM   forestation
                           WHERE  year_fa = 2016
                                  AND c_name_fa LIKE '%United States');
```

Recommendations:

```
WITH f2016
    AS (SELECT c_name_fa        cn2016,
               forest_area_sqkm forest2016,
               region,
               total_area_sqkm  land_area,
               year_la          y2016
```

```
        FROM   forestation
        WHERE  year_fa = 2016),
    f1990
    AS (SELECT c_name_fa        cn1990,
               forest_area_sqkm forest1990,
               year_la          y1990
        FROM   forestation
        WHERE  year_fa = 1990)
SELECT cn2016,
       y2016,
       region,
       Round(( ( forest2016 - forest1990 ) / forest1990 * 100 ) :: NUMERIC)
       change_of_forest_pct,
       land_area
FROM   f2016 a
       join f1990 b
         ON a.cn2016 = b.cn1990
WHERE  ( forest2016 - forest1990 ) IS NOT NULL
       AND cn2016 IN( 'Iceland', 'China', 'Brazil' )
ORDER  BY 4 DESC;
```