Raghad Alamoudi

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 41282695 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958246, a loss of 1324449, 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 12).

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.

2.1: Percent Forest Area by Region, 1990 & 2016:

Region	1990 Forest Percentage	2016 Forest Percentage
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04
South Asia	16.51	17.51
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 increased in forest area from 1990 to 2016 by 527229.06. 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 Unites States, but it only saw an increase of 79200, much lower than the figure for Iceland.

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	282193.9844
Myanmar	East Asia & Pacific	107234.0039
Nigeria	Sub-Saharan Africa	106506.00098
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	75.4452
Nigeria	Sub-Saharan Africa	61.7999
Uganda	Sub-Saharan Africa	59.1286
Mauritania	Sub-Saharan Africa	46.7498
Honduras	Latin America & Caribbean	45.0344

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, 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	72
3	38
4	9

The largest number of countries in 2016 were found in the **First** quartile. There were **9** countries in the top quartile (fourth 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	Percentages Designated as Forest
American Samoa	East Asia & Pacific	87.5
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Palau	East Asia & Pacific	87.61
Seychelles	Sub-Saharan Africa	88.41
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26

4. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.

- *What have you learned from the World Bank data?*

Globally, the total area of forests decreased by 3.02 percent between 1990 and 2016. This decline is caused by a variety of issues, including pasturage saturation, illicit deforestation, corruption, climate change, and resource trafficking.

Aside from the fact that the majority of the world's regions have seen a rise in their forest cover, just two have seen a loss in it: Latin America and the Caribbean and Sub-Saharan Africa.

Since 1990, several nations and governments have made significant efforts to raise the mass of threes globally. But maintaining the best possible harmony in nature will be difficult.

- *Which countries should we focus on over others?*

1. Nigeria should be the primary area of attention because it is one of the top 5 nations in terms of the amount and percentage of forest area lost.

2. Because they have lost the most forest area, Brazil, Indonesia, Myanmar, and Tanzania should be the focus of attention.

3.Sub-Saharan Africa is a region that needs more attention because it has lost the most forest acreage overall.

5. APPENDIX: SQL queries used

Part 1:

```sql
/*Create View forestation */
CREATE VIEW forestation AS
SELECT a.country_code, a.country_name, re.region,
    a.forest_area_sqkm,(la.total_area_sq_mi * 2.59) AS total_area_sqkm,
    (100.0* a.forest_area_sqkm /
    (la.total_area_sq_mi * 2.59)) AS presentage_of_land,
    re.income_group, a.year
FROM forest_area a
JOIN land_area la
    ON a.country_code = la.country_code
        AND a.year = la.year
JOIN regions re
    ON re.country_code = a.country_code;

--PART 1: Global Situation
--a
SELECT a.forest_area_sqkm
        FROM forest_area a
        WHERE a.country_name = 'World'
            AND a.year = 1990;
--b
SELECT a.forest_area_sqkm
        FROM forest_area a
        WHERE a.country_name = 'World'
            AND a.year = 2016;
```

```sql
-- c
SELECT s1.forest_area_sqkm - s2.forest_area_sqkm AS forest_area_sq_km
     FROM (SELECT a.country_code AS contry_code, a.forest_area_sqkm
           FROM forest_area a
             WHERE a.country_name = 'World'
               AND a.year = 1990) AS s1
     JOIN (SELECT a.country_code AS country_code,a.forest_area_sqkm
           FROM forest_area a
             WHERE a.country_name = 'World'
               AND a.year = 2016) AS s2
     ON s1 = s2;
-- d
-- s1 stand for sub1
-- s2 stand for sub2
SELECT ((s1.forest_area_sqkm-s2.forest_area_sqkm)/s1.forest_area_sqkm)*100  AS
       percantage_change_forest_area
     FROM (SELECT a.country_code AS cc, a.forest_area_sqkm
           FROM amount_of_forest_area
             WHERE a.country_name = 'World'
               AND a.year = 1990) AS s1
     JOIN (SELECT a.country_code AS a.forest_area_sqkm
           FROM forest_area a
             WHERE a.country_name = 'World'
               AND a.year = 2016) AS s2
     ON s1 = s2;
-- e
-- s1 stand for sub1
-- s2 stand for sub2
SELECT la.country_name,
      la.total_area_sq_mi*2.59 AS total_forest_area_sqkm,
      ABS((la.total_area_sq_mi*2.59)- (SELECT s1.forest_area_sqkm - s2.forest_area_sqkm AS
           forest_area_sq_km
    FROM (SELECT a.country_code AS country_code, a.forest_area_sqkm
    FROM forest_area a
    WHERE a.country_name = 'World'
    AND a.year = 1990) AS s1
   JOIN (SELECT a.country_code AS country_code,a.forest_area_sqkm
       FROM forest_area a
       WHERE a.country_name = 'World'
       AND a.year = 2016) AS s2
       ON s1.country_code = s2.country_code)) AS forest_land_sqkm
   FROM land_area la
   WHERE la.year = 2016
   ORDER BY 3 LIMIT 1;
```

Part 2:

```sql
--Part 2: Regional Outlook
-- Create a table that shows the Regions and their percent forest area
-- (sum of forest area divided by sum of land area) in 1990 and 2016.
-- (Note that 1 sq mi = 2.59 sq km). Based on the table you created, ....
CREATE VIEW Regional
AS
SELECT re.region,
       la.year,
       SUM(a.forest_area_sqkm) total_forest_area_sqkm,
       SUM(la.total_area_sq_mi*2.59) AS total_area_sqkm,
       -- the sum of the forest area divided by the sum of the land are in 1990 to 2016
        (SUM(a.forest_area_sqkm)/SUM(la.total_area_sq_mi*2.59))*100 AS percentage_fa_region
      -- a is short for area of the forest
      FROM forest_area a
      -- la is short for land area
      JOIN land_area la
      ON a.country_code = la.country_code AND a.year = la.year
      -- re is short for regions
      JOIN regions re
      ON la.country_code = re.country_code
      GROUP BY 1,2
      ORDER BY 1,2;
-- a
-- fa stand for forest area
SELECT ROUND(CAST(percentage_fa_region AS numeric),2) AS percentage_fa_region
       FROM Regional
     WHERE year = 2016 AND region = 'World';
SELECT region,
       ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,
       ROUND(CAST(percentage_fa_region AS NUMERIC),2) AS percentage_fa_region
       FROM Regional
       WHERE ROUND(CAST(percentage_fa_region AS NUMERIC),2) = (SELECT MAX( ROUND(
        CAST(percentage_fa_region AS numeric),2)) AS maximum_percentage
        FROM Regional
        WHERE year = 2016) AND year=2016;
SELECT region,
       ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,
       ROUND(CAST(percentage_fa_region AS NUMERIC),2) AS percentage_fa_region
          FROM Regional
          WHERE ROUND(CAST(percentage_fa_region AS NUMERIC),2) = (SELECT MIN(ROUND(
           CAST(percentage_fa_region AS numeric),2)) AS minimum_percentage
           FROM Regional
           WHERE year = 2016) AND year = 2016;
```

```sql
-- b
-- fa stand for forest area
SELECT ROUND(CAST(percentage_fa_region AS numeric),2) AS percentage_fa_region
       FROM Regional
     WHERE year = 1990 AND region = 'World';
SELECT region,
    ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,
    ROUND(CAST(percentage_fa_region AS NUMERIC),2) AS percentage_fa_region
    FROM Regional
        WHERE ROUND(CAST(percentage_fa_region AS NUMERIC),2) = (SELECT MAX( ROUND(
        CAST(percentage_fa_region AS numeric),2)) AS maximum_percentage
        FROM regional
        WHERE year = 1990)AND year=1990;
  SELECT region,
       ROUND(CAST(total_area_sqkm AS NUMERIC),2) AS total_area_sqkm,
       ROUND(CAST(percentage_fa_region AS NUMERIC),2) AS percentage_fa_region
          FROM Regional
          WHERE ROUND(CAST(percentage_fa_region AS NUMERIC),2) = (SELECT MIN(ROUND(
           CAST(percentage_fa_region AS numeric),2)) AS minimum_percentage
           FROM Regional
           WHERE year = 1990) AND year = 1990;
-- c
-- this is the table for 1990 and the table for 2016 to see it descreasing in time
WITH table_of_1990 AS (SELECT * FROM Regional WHERE year =1990),
     table_of_2016 AS (SELECT * FROM Regional WHERE year = 2016)
SELECT table_of_1990.region,
       ROUND(CAST(table_of_1990.percentage_fa_region AS NUMERIC),2) AS forest_area_1990,
       ROUND(CAST(table_of_2016.percentage_fa_region AS NUMERIC),2) AS forest_area_2016
   FROM table_of_1990 JOIN table_of_2016 ON table_of_1990.region = table_of_2016.region
   WHERE table_of_1990.percentage_fa_region > table_of_2016.percentage_fa_region;
```

Part 3:

```sql
--Part 3: Country-Level Detail
-- a
-- this is the table for 1990 and the table for 2016
WITH table_of_1990 AS (SELECT a.country_code, a.country_name,a.year, a.forest_area_sqkm
                       FROM forest_area a
                       WHERE a.year = 1990 AND a.forest_area_sqkm IS NOT NULL AND a.country_name != 'World'),
     table_of_2016 AS (SELECT a.country_code, a.country_name, a.year, a.forest_area_sqkm
                       FROM forest_area a
                       WHERE a.year = 2016 AND a.forest_area_sqkm IS NOT NULL AND a.country_name != 'World')
 SELECT table_of_1990.country_code,table_of_1990.country_name,
        re.region,
        table_of_1990.forest_area_sqkm AS forest_area_1990_sqkm,
        table_of_2016.forest_area_sqkm AS forest_area_2016_sqkm,
        table_of_1990.forest_area_sqkm-table_of_2016.forest_area_sqkm AS forest_area_sqkm
     FROM table_of_1990
     JOIN table_of_2016
     ON table_of_1990.country_code = table_of_2016.country_code
     AND (table_of_1990.forest_area_sqkm IS NOT NULL AND table_of_2016.forest_area_sqkm IS NOT NULL)
     JOIN regions re ON table_of_2016.country_code = re.country_code
     ORDER BY 6 DESC
     LIMIT 5;
-- b
WITH table_of_1990 AS (SELECT a.country_code, a.country_name, a.year, a.forest_area_sqkm
                         FROM forest_area a
                       WHERE a.year = 1990 AND a.forest_area_sqkm IS NOT NULL AND a.country_name != 'World'),

     table_of_2016 AS (SELECT a.country_code, a.country_name, a.year, a.forest_area_sqkm
                         FROM forest_area a
                       WHERE a.year = 2016 AND a.forest_area_sqkm IS NOT NULL AND a.country_name != 'World')
 SELECT table_of_1990.country_code, table_of_1990.country_name,
        re.region,
        table_of_1990.forest_area_sqkm AS fa_1990_sqkm,
        table_of_2016.forest_area_sqkm AS fa_2016_sqkm,
        table_of_1990.forest_area_sqkm-table_of_2016.forest_area_sqkm AS forest_area_sqkm,
        ABS(ROUND(CAST(((table_of_2016.forest_area_sqkm-table_of_1990.forest_area_sqkm)/table_of_1990.forest_area_sqkm*100)
        AS NUMERIC),2)) AS percantage_change
     FROM table_of_1990
     JOIN table_of_2016
     ON table_of_1990.country_code = table_of_2016.country_code
     AND (table_of_1990.forest_area_sqkm IS NOT NULL AND table_of_2016.forest_area_sqkm IS NOT NULL)
     JOIN regions re ON table_of_2016.country_code = re.country_code
     ORDER BY ROUND(CAST(((table_of_2016.forest_area_sqkm-table_of_1990.forest_area_sqkm)/table_of_1990.forest_area_sqkm*100)
     AS NUMERIC),2)
     LIMIT 5;
```

```sql
-- c
-- t1 stand for table1
-- t2 stand for table2
-- fa stand for forest area
With t1 AS (SELECT a.country_code, a.country_name, a.year, a.forest_area_sqkm,
                   la.total_area_sq_mi*2.59 AS total_area_sqkm,
                      -- typing the equation
                      (a.forest_area_sqkm/(la.total_area_sq_mi*2.59))*100 AS percentage_fa
                      FROM forest_area a
                      JOIN land_area la
                      ON a.country_code = la.country_code
                      AND (a.country_name != 'World' AND a.forest_area_sqkm IS NOT NULL AND la.total_area_sq_mi IS NOT NULL)
                      AND (a.year=2016 AND la.year = 2016)
                      ORDER BY 6 DESC),
     t2 AS (SELECT t1.country_code, t1.country_name, t1.year,t1.percentage_fa,
                    CASE WHEN t1.percentage_fa >= 75 THEN 4
                         WHEN t1.percentage_fa < 75 AND t1.percentage_fa >= 50 THEN 3
                         WHEN t1.percentage_fa < 50 AND t1.percentage_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;
-- d
-- t1 stand for table1
-- t2 stand for table2
-- fa stand for forest area
With t1 AS (SELECT a.country_code, a.country_name, a.year, a.forest_area_sqkm,
                   la.total_area_sq_mi*2.59 AS total_area_sqkm,
                    -- typing the equation
                      (a.forest_area_sqkm/(la.total_area_sq_mi*2.59))*100 AS percentage_fa
                      FROM forest_area a
                      JOIN land_area la
                      ON a.country_code = la.country_code
                      AND (a.country_name != 'World' AND a.forest_area_sqkm IS NOT NULL AND la.total_area_sq_mi IS NOT NULL)
                      AND (a.year=2016 AND la.year = 2016)
                      ORDER BY 6 DESC),
     t2 AS (SELECT t1.country_code, t1.country_name, t1.year,
                    t1.percentage_fa,
                    CASE WHEN t1.percentage_fa >= 75 THEN 4
                         WHEN t1.percentage_fa < 75 AND t1.percentage_fa >= 50 THEN 3
                         WHEN t1.percentage_fa < 50 AND t1.percentage_fa >=25 THEN 2
                         ELSE 1
                    END AS percentile
                    FROM t1 ORDER BY 5 DESC)
SELECT t2.country_name, re.region,
       ROUND(CAST(t2.percentage_fa AS NUMERIC),2) AS percentage_fa,
       t2.percentile
       FROM t2
       JOIN regions re
       ON t2.country_code = re.country_code
       WHERE t2.percentile = 4
       ORDER BY 1;
-- e
```

```sql
-- e
-- t1 stand for table1
-- fa stand for forest area
With t1 AS (SELECT a.country_code, a.country_name, a.year, a.forest_area_sqkm,
                  la.total_area_sq_mi*2.59 AS total_area_sqkm,
                  -- typing the equation
                   (a.forest_area_sqkm/(la.total_area_sq_mi*2.59))*100 AS percentage_fa
                   FROM forest_area a
                   JOIN land_area la
                   ON a.country_code = la.country_code
                   AND (a.country_name != 'World' AND a.forest_area_sqkm IS NOT NULL AND la.total_area_sq_mi IS NOT NULL)
                   AND (a.year=2016 AND la.year = 2016)
                   ORDER BY 6 DESC)
SELECT COUNT(t1.country_name)
     FROM t1
     WHERE t1.percentage_fa > (SELECT t1.percentage_fa
                               FROM t1
                               WHERE t1.country_name = 'United States')
```