Report for ForestQuery into Global Deforestation, 1990 to 2016

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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 $41.282.696km^2$ in 1990. As of 2016, the most recent year for which data was available, that number had fallen to $39.958.244km^2$, a loss of $1.324.452km^2$, 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 $1.280.000,02km^2$).

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.

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

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

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 $527.229km^2$. 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 $79.200km^2$, 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 $68,12$% 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:

Country	Region	Absolute Forest Area Change
Brazil	Latin America & Caribbean	541.510 sq km
Indonesia	East Asia & Pacific	282.194 sq km
Myanmar	East Asia & Pacific	107.234 sq km
Nigeria	Sub-Saharan Africa	106.506 sq km
Tanzania	Sub-Saharan Africa	102.320 sq km

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016

The second way to consider which countries are of concern is to analyze the data by percent decrease.

Country	Region	Pct Forest Area Change
Togo	Sub-Saharan Africa	307,25%
Nigeria	Sub-Saharan Africa	161,78%
Uganda	Sub-Saharan Africa	144,67%
Mauritania	Sub-Saharan Africa	87,78%
Honduras	Latin America & Caribbean	81,93%

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016

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

Quartile	Number of Countries
1st quartile	85
2nd quartile	72
3rd quartile	38
4th quartile	9
Not enough information	13

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016

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.

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%

Table 3.4: Top Quartile Countries, 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?

That maybe, the population growth is not an excuse to reduce forest's areas because a country like China, with over a billion people, has instead increased the area of its forests.

- Which countries should we focus on over others?

We should focus on countries that are present in Table 3.1 and Table 3.2, specially Nigeria. Also, make efforts to move countries away from the first quartile.

5. APPENDIX: SQL QUERIES

Listing 1: forestation View

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

QUERIES FOR PART 1: GLOBAL SITUATION

Listing 2: 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  region = 'World'
       AND "year" = 1990
```

Listing 3: 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 "year",
       region,
       forest_area_sqkm AS total_forest_area_sq_km
FROM   forestation
WHERE  "year" = 2016
       AND region = 'World'
```

Listing 4: What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
WITH area_1990
     AS (SELECT forest_area_sqkm,
                region
         FROM   forestation
         WHERE  "year" = 1990
                AND region = 'World'),
     area_2016
     AS (SELECT forest_area_sqkm,
                region
         FROM   forestation
         WHERE  "year" = 2016
                AND region = 'World')
SELECT area_1990.region,
       ( area_1990.forest_area_sqkm - area_2016.forest_area_sqkm )
       AS diff_area
FROM   area_2016
       JOIN area_1990
         ON area_2016.region = area_1990.region
```

Listing 5: What was the percent change in forest area of the world between 1990 and 2016?

```
WITH area_1990
     AS (SELECT forest_area_sqkm,
                region
         FROM   forestation
         WHERE  "year" = 1990
                AND region = 'World'),
     area_2016
     AS (SELECT forest_area_sqkm,
                region
         FROM   forestation
         WHERE  "year" = 2016
                AND region = 'World')
SELECT area_1990.region,
       area_1990.forest_area_sqkm AS frst_area_1990,
       area_2016.forest_area_sqkm AS frst_area_2016,
       ( area_1990.forest_area_sqkm - area_2016.forest_area_sqkm )
       AS loss_area,
       ( area_1990.forest_area_sqkm - area_2016.forest_area_sqkm ) /
       area_1990.forest_area_sqkm * 100 AS loss_perc
FROM   area_2016
       JOIN area_1990
         ON area_2016.region = area_1990.region
```

Listing 6: 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 area_1990
     AS (SELECT forest_area_sqkm,
                region
         FROM   forestation
         WHERE  "year" = 1990
                AND region = 'World'),
     area_2016
     AS (SELECT forest_area_sqkm,
                region
         FROM   forestation
         WHERE  "year" = 2016
                AND region = 'World')
SELECT f.country_name,
       f.total_area_sq_mi * 2.59 AS total_area_sqkm
FROM   (SELECT ( area_1990.forest_area_sqkm - area_2016.forest_area_sqkm )
        AS loss_area
        FROM   area_1990
               JOIN area_2016
                 ON area_2016.region = area_1990.region) AS sub
       JOIN forestation f
         ON f.total_area_sq_mi < sub.loss_area
            AND year = 2016
WHERE  total_area_sq_mi * 2.59 < sub.loss_area
       AND total_area_sq_mi IS NOT NULL
ORDER  BY total_area_sqkm desc
LIMIT 1;
```

QUERIES FOR PART 2: REGIONAL OUTLOOK

Listing 7: Required Table

```
SELECT "year",
       region,
       SUM(forest_area_sqkm) AS forest_area_by_region
FROM   forestation
WHERE  ( "year" = 1990 AND region != 'World' )
        OR ( "year" = 2016 AND region != 'World' )
GROUP  BY "year", region
ORDER  BY "year"
```

Listing 8: 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?

```
SELECT f.region,
ROUND(
( SUM(f.forest_area_sqkm) / ( Sum(f.total_area_sq_mi * 2.59) ) * 100 ) :: ↩
   NUMERIC, 2) AS perc_forest
FROM   forestation f
WHERE  f."year" = 2016
       AND f.region = 'World'
GROUP  BY f.region
```

Listing 9: Percentage of forest by region 2016

```
ELECT f.region,
ROUND(
( SUM(f.forest_area_sqkm) / ( Sum(f.total_area_sq_mi * 2.59) ) * 100 ) :: ↩
   NUMERIC, 2) AS perc_forest
FROM   forestation f
WHERE  f."year" = 2016
GROUP  BY f.region
ORDER  BY perc_forest DESC
```

Listing 10: 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?

```
SELECT f.region,
ROUND(
( SUM(f.forest_area_sqkm) / ( Sum(f.total_area_sq_mi * 2.59) ) * 100 ) :: ↩
    NUMERIC, 2) AS perc_forest
FROM   forestation f
WHERE  f."year" = 1990
       AND f.region = 'World'
GROUP  BY f.region
```

Listing 11: Percentage of forest by region 1990

```
SELECT f.region,
ROUND(
( SUM(f.forest_area_sqkm) / ( Sum(f.total_area_sq_mi * 2.59) ) * 100 ) :: ↩
    NUMERIC, 2) AS perc_forest
FROM   forestation f
WHERE  f."year" = 1990
GROUP  BY f.region
ORDER  BY perc_forest DESC
```

Listing 12: Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

```
WITH forest_1990
     AS (SELECT f.region,
ROUND(
( SUM(f.forest_area_sqkm) / ( SUM(f.total_area_sq_mi * 2.59) ) * 100 ) :: ↩
   NUMERIC, 2) AS perc_forest
 FROM   forestation f
 WHERE  f."year" = 1990
 GROUP  BY f.region),
     forest_2016
     AS (SELECT f.region,
ROUND(
( SUM(f.forest_area_sqkm) / ( SUM(f.total_area_sq_mi * 2.59) ) * 100 ) :: ↩
   NUMERIC, 2) AS perc_forest
 FROM   forestation f
 WHERE  f."year" = 2016
 GROUP  BY f.region)
SELECT forest_1990.region,
       ( forest_2016.perc_forest - forest_1990.perc_forest ) AS diff_perc
FROM   forest_1990
       join forest_2016
         ON forest_1990.region = forest_2016.region
GROUP  BY forest_1990.region,
          diff_perc
ORDER  BY diff_perc
```

QUERIES FOR PART 3: COUNTRY-LEVEL DETAIL

Listing 13: 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 sq_1990
     AS (SELECT forest_area_sqkm forest_country_1990,
                country_name
         FROM   forestation
         WHERE  "year" = 1990
                AND country_name != 'World'
                AND forest_area_sqkm IS NOT NULL),
     sq_2016
     AS (SELECT forest_area_sqkm forest_country_2016,
                country_name
         FROM   forestation
         WHERE  "year" = 2016
                AND country_name != 'World'
                AND forest_area_sqkm IS NOT NULL)
SELECT sq_2016.country_name,
       sq_1990.forest_country_1990 AS forest_country_1990,
       sq_2016.forest_country_2016 AS forest_country_2016,
       ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990 )
       AS diff,
       CASE
         WHEN ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990 ↩
             )
         > 0
       THEN
         CONCAT('Gained ', sq_2016.forest_country_2016 -
                           sq_1990.forest_country_1990,
       ' sqkm of forest'
       )
         WHEN ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990 ↩
             )
         < 0
       THEN
         CONCAT('Lost ', sq_1990.forest_country_1990 -
                         sq_2016.forest_country_2016,
         ' sqkm of forest'
       )
         ELSE 'Maintained the forest area'
       END AS difference_btween_1990_2016
FROM   sq_2016
       JOIN sq_1990
         ON sq_1990.country_name = sq_2016.country_name
GROUP  BY sq_2016.country_name,
```

```
          forest_country_1990,
          forest_country_2016
ORDER  BY diff DESC
```

Listing 14: 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 sq_1990
     AS (SELECT forest_area_sqkm forest_country_1990,
                country_name
         FROM   forestation
         WHERE  "year" = 1990
                AND country_name != 'World'
                AND forest_area_sqkm IS NOT NULL),
     sq_2016
     AS (SELECT forest_area_sqkm forest_country_2016,
                country_name
         FROM   forestation
         WHERE  "year" = 2016
                AND country_name != 'World'
                AND forest_area_sqkm IS NOT NULL)
SELECT sq_2016.country_name,
       sq_1990.forest_country_1990 AS forest_country_1990,
       sq_2016.forest_country_2016 AS forest_country_2016,
       ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990 )
       AS diff,
       ROUND(( ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990
       )/ ( sq_2016.forest_country_2016 ) * 100 )::NUMERIC, 2)
       AS percentage_change,
       CASE
         WHEN ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990
         ) > 0
         THEN CONCAT('Gained ', ROUND((( sq_2016.forest_country_2016 -
sq_1990.forest_country_1990 ) / ( sq_2016.forest_country_2016 )
* 100 )::NUMERIC, 2), '% of forest')
         WHEN ( sq_2016.forest_country_2016 - sq_1990.forest_country_1990
         ) < 0
         THEN CONCAT('Lost ', ABS(ROUND((( sq_2016.forest_country_2016 -
sq_1990.forest_country_1990 ) /( sq_2016.forest_country_2016 )
* 100 )::NUMERIC, 2)), '% of forest')
         ELSE 'Maintained the forest area'
       END AS difference_btween_1990_2016
FROM   sq_2016
       JOIN sq_1990
         ON sq_1990.country_name = sq_2016.country_name
```

```
GROUP  BY sq_2016.country_name,
          forest_country_1990,
          forest_country_2016
ORDER  BY percentage_change DESC
```

Listing 15: If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
SELECT COUNT(country_name) AS cnt,
       CASE
         WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) * 100 )
         BETWEEN 0 AND 25 THEN '1st quartile'
         WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) * 100 )
         BETWEEN 25.01 AND 50 THEN '2nd quartile'
         WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) * 100 )
         BETWEEN 50.01 AND 75 THEN '3rd quartile'
         WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 ) * 100 )
         BETWEEN 75.01 AND 100 THEN '4th quartile'
         ELSE 'Not enough information'
       end AS quartiles
FROM   forestation
WHERE "year" = 2016 AND country_name != 'World'
GROUP BY quartiles
ORDER BY cnt DESC
```

Listing 16: List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

```
WITH qrt_2016
     AS (SELECT country_name,
            "year",
             CASE
                 WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 )
                 * 100 ) BETWEEN 0 AND 25 THEN '1st quartile'
                 WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 )
                 * 100 ) BETWEEN 25.01 AND 50 THEN '2nd quartile'
                 WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 )
                 * 100 ) BETWEEN 50.01 AND 75 THEN '3rd quartile'
                 WHEN ( forest_area_sqkm / ( total_area_sq_mi * 2.59 )
                 * 100 ) BETWEEN 75.01 AND 100 THEN '4th quartile'
                 ELSE "Not enough information"
             END AS quartiles
         FROM   forestation
         WHERE "year" = 2016 AND country_name != 'World')
SELECT f.country_name,
       f.region,
       ROUND(( f.forest_area_sqkm / ( f.total_area_sq_mi * 2.59 )
       * 100 )::NUMERIC, 2) AS forest_perc
FROM   qrt_2016
       JOIN forestation f
         ON qrt_2016.country_name = f.country_name
WHERE  qrt_2016.quartiles = '4th quartile' AND f."year" = 2016
ORDER  BY forest_perc DESC
```

Listing 17: How many countries had a percent forestation higher than the United States in 2016?

```
SELECT COUNT(*) AS cnt
FROM   forestation f
WHERE  f."year" = 2016
       AND ROUND(( f.forest_area_sqkm / ( f.total_area_sq_mi * 2.59 )
       * 100 )::NUMERIC,2) > (SELECT ROUND(( f.forest_area_sqkm /
       ( f.total_area_sq_mi * 2.59 ) * 100 )::NUMERIC,2)
                FROM   forestation f
                WHERE  country_name = 'United States'
                       AND "year" = 2016)
```