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 sq km_ in 1990. As of 2016, the most recent year for which data was available, that number had fallen to _39,958,245.9 sq km_, a loss of __1,324,449 sq km_, 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 __1,279,999.99_sq km____).

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_Larin 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 __527229.062 sq 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 sq km____, 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 (sq km)
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282193.98
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 (sq km)
Togo	Sub-Saharan Africa	5,168
Nigeria	Sub-Saharan Africa	106,506
Uganda	Sub-Saharan Africa	28,092
Mauritania	Sub-Saharan Africa	1,940
Honduras	Latin America & Caribbean	36,640

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

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

Quartile	Number of Countries
1st	85
2nd	73
3rd	38
4th	9

The largest number of countries in 2016 were found in the _fourth_ 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

5. 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?*

I have learnt that all the regions of the World have expanded their area of forest lands except for Sub-Saharan Africa and Latin America & Caribbean. However, the proportion of forest land to the total area of the world decreased from 1990 to 2016. This is an indication that the rate of deforestation in these two regions is greater than the combined efforts of forestation by the six other regions of the world. This is the reason for the net reduction in the proportion of forest area in the world though some regions are taking deliberate steps to preserve and increase their forest coverage.

The increase in forest area by China is worthy of emulation by other countries of the world. Countries which have realized a reduction in their forest reserves over the period, could adapt China's strategy to increase their forest area soon. Even though China had the greatest increase in forest area from 1990 to 2016, it still falls in the first quartile of forest percentage. This gives an indication of the situation in China prior to 1990. Sub-Saharan Africa and Latin America & Caribbean need to pay attention to the lost of forest reserves which have occurred in these regions for the time under review.

Appendix: SQL Queries Used

1. GLOBAL

```
/* create forestion VIEW */
DELETE FROM forest_area WHERE forest_area_sqkm is NULL;
DELETE FROM land_area WHERE total_area_sq_mi is NULL;

CREATE OR REPLACE VIEW forestation 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,
        r.region, r.income_group,
        f.forest_area_sqkm / (l.total_area_sq_mi * 2.59) * 100 AS percent_forest
  FROM forest_area f
  JOIN land_area l
  ON f.country_code = l.country_code
  AND f.year = l.year
  JOIN regions r
  ON f.country_code = r.country_code;

/* total forest area of World, 1990 */
SELECT SUM(forest_area_sqkm)
FROM forestation
WHERE year = 1990
AND country_name LIKE 'World';

/* total forest area of World, 2016 */
SELECT SUM(forest_area_sqkm)
FROM forestation
WHERE year = 2016
AND country_name LIKE 'World';

/* get difference in forest area lost */
SELECT
  (SELECT SUM(forest_area_sqkm)
  FROM forestation
  WHERE year = 1990
  AND country_name LIKE 'World') -
  (SELECT SUM(forest_area_sqkm)
  FROM forestation
  WHERE year = 2016
  AND country_name LIKE 'World') diff;

/* get prop_change in forest area lost */
SELECT
  (((SELECT SUM(forest_area_sqkm)
```

```
  FROM forestation
  WHERE year = 1990
  AND country_name LIKE 'World') -
  (SELECT SUM(forest_area_sqkm)
  FROM forestation
  WHERE year = 2016
  AND country_name LIKE 'World')) /
     (SELECT SUM(forest_area_sqkm)
     FROM forestation
     WHERE year = 1990
     AND country_name LIKE 'World')) * 100 percent_loss

/* diff is more than area of country */
SELECT country_name, total_area_sqkm
FROM forestation
WHERE total_area_sqkm <
    (SELECT
      (SELECT SUM(forest_area_sqkm)
      FROM forestation
      WHERE year = 1990
      AND country_name LIKE 'World') -
      (SELECT SUM(forest_area_sqkm)
      FROM forestation
      WHERE year = 2016
      AND country_name LIKE 'World') diff)
GROUP BY 1, 2
ORDER BY 2 DESC
LIMIT 1;

/* percent of forest land, 2016 */
SELECT year, region, percent_forest
FROM forestation
WHERE year = 2016
AND country_name LIKE 'World'
ORDER BY 3 DESC
LIMIT 1;

/* create VIEW to hold relative_forest */
/* region with highest relative forest */
DROP VIEW if exists relative_forest;
CREATE VIEW relative_forest as
SELECT year, region,
       SUM(forest_area_sqkm)/SUM(total_area_sqkm) * 100 relative_forest
FROM forestation
```

```
GROUP BY 1, 2;

/* 3. REGIONAL OUTLOOK */
/* region with highest relative forest, 2016 */
SELECT region, relative_forest
FROM relative_forest
WHERE year = 2016
ORDER BY 2 DESC
LIMIT 1;

/* region with lowest relative forest, 2016 */
SELECT year, region, relative_forest
FROM relative_forest
WHERE year = 2016
ORDER BY 3
LIMIT 1;


/* forest percent of land, 1990 */
SELECT year, percent_forest
FROM forestation
WHERE year = 1990
AND country_name LIKE 'World'

/* region with highest relative forest, 1990 */
SELECT region, relative_forest
FROM relative_forest
WHERE year = 1990
ORDER BY 2 DESC
LIMIT 1;

/* region with lowest relative forest, 1990 */
SELECT region, relative_forest
FROM relative_forest
WHERE year = 1990
ORDER BY 2
LIMIT 1;

/* table 1 */
WITH t1_2016 as (
  SELECT region, relative_forest
  FROM relative_forest
  WHERE year = 2016
  ORDER BY 2 DESC
```

```
  ), t2_1990 as (
   SELECT region, relative_forest
  FROM relative_forest
  WHERE year = 1990
  ORDER BY 2 DESC
    )
    SELECT t1_2016.region, t2_1990.relative_forest percentage_forest_1990,
        t1_2016.relative_forest percentage_forest_2016
  FROM t1_2016
  JOIN t2_1990
  ON t1_2016.region = t2_1990.region;

/* regions with decreased relative forests */
  WITH t1_2016 as (
    SELECT region, relative_forest
    FROM relative_forest
    WHERE year = 2016
    ORDER BY 2 DESC
    ), t2_1990 as (
     SELECT region, relative_forest
    FROM relative_forest
    WHERE year = 1990
    ORDER BY 2 DESC
      )
      SELECT t1_2016.region, t2_1990.relative_forest percentage_forest_1990,
          t1_2016.relative_forest percentage_forest_2016
    FROM t1_2016
    JOIN t2_1990
    ON t1_2016.region = t2_1990.region
    WHERE percentage_forest_2016 < percentage_forest_1990
    AND t1_2016.region != 'World';


/* 3. COUNTRY LEVEL DETAIL */
/* A. Success stories */
WITH t1 as(
  SELECT country_name, forest_area_sqkm
  FROM forestation
  WHERE year = 1990
), t2 as (
  SELECT country_name, forest_area_sqkm
  FROM forestation
  WHERE year = 2016
), t3 as (
```

```
SELECT t1.country_name,
       t1.forest_area_sqkm forest_area_sqkm_1990,
       t2.forest_area_sqkm forest_area_sqkm_2016
FROM t1 JOIN t2
ON t1.country_name = t2.country_name
)
SELECT t3.country_name,
     t3.forest_area_sqkm_1990,
     t3.forest_area_sqkm_2016,
     t3.forest_area_sqkm_2016 - t3.forest_area_sqkm_1990 diff_sqkm,
     (t3.forest_area_sqkm_2016 - t3.forest_area_sqkm_1990) /
        t3.forest_area_sqkm_1990 * 100 AS percent_change
FROM t3
WHERE forest_area_sqkm_1990 < forest_area_sqkm_2016
/*  choose order by percent_change or diff to ans question */
ORDER BY diff_sqkm DESC
LIMIT 5

/* Largest concerns */
/* Deforestation */
WITH t1 as(
  SELECT country_name, region, forest_area_sqkm
  FROM forestation
  WHERE year = 1990
), t2 as (
  SELECT country_name, region, forest_area_sqkm
  FROM forestation
  WHERE year = 2016
), t3 as (
SELECT t1.country_name, t1.region,
       t1.forest_area_sqkm forest_area_sqkm_1990,
       t2.forest_area_sqkm forest_area_sqkm_2016
FROM t1 JOIN t2
ON t1.country_name = t2.country_name
)

SELECT t3.country_name, t3.region,
     ABS(t3.forest_area_sqkm_2016 - t3.forest_area_sqkm_1990) abs_diff_sqkm,
     (t3.forest_area_sqkm_2016 - t3.forest_area_sqkm_1990) /
       t3.forest_area_sqkm_1990 * 100 percentage_change
FROM t3
WHERE forest_area_sqkm_1990 > forest_area_sqkm_2016
AND country_name NOT LIKE 'World'
/*  choose ORDER BY percentage_change or abs_diff_sqkm to ans question */
```

```
ORDER BY percentage_change
LIMIT 5;


/* QUARTILES */
CREATE OR REPLACE VIEW quart_table as
   SELECT country_name, region, percent_forest,
        CASE  WHEN percent_forest < 25 THEN 1
            WHEN percent_forest < 50 THEN 2
            WHEN percent_forest < 75 THEN 3
            ELSE 4 END AS quartile
   FROM forestation
   WHERE year = 2016;

SELECT quartile, count(*)
FROM quart_table
GROUP BY quartile
ORDER BY quartile;

/* top quartile countries */
SELECT country_name, region, percent_forest
FROM quart_table
WHERE quartile = 4
ORDER BY percent_forest DESC;
```