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 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	Difference
Latin America & Caribbean	51.03	46.16	-4.87
Sub-Saharan Africa	30.67	28.79	-1.88
World	32.42	31.38	-1.04
Middle East & North Africa	1.78	2.07	0.29
North America	35.65	36.04	0.39
East Asia & Pacific	25.78	26.36	0.58
Europe & Central Asia	37.28	38.04	0.76
South Asia	16.51	17.51	1.00

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 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 79,200.00 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
Brazil	Latin America & Caribbean	541,510.00
Indonesial	East Asia & Pacific	282,193.98
Myanmar	East Asia & Pacific	107,234.00
Nigeria	Sub-Saharan Africa	106,506.00
Tanzania	Sub-Saharan Africa	102,320.00

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	59.13
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
American Samoa	East Asia & Pacific	87.50
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11

Palau	East Asia & Pacific	87.61
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26
Seychelles	Sub-Saharan Africa	88.41

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?*

From the analysis by the world bank, the data shows that the world has lost 3.2 % of its forest coverage from 1990 (41,282,694.9 sq. km) to 2016 (39,958,245.9 sq. km), which is 1,324,449 sq. km. An area larger than Peru.

China and the United States are those countries that increased their forest area from 1990 to 2016 in terms of total land area.
Looking at the highest percentage change in forest increase, Iceland leads with an increase of 213%.

In comparison, countries of the Sub-Saharan Africa region are becoming a big concern as four of its countries with the highest decrease of the area in percentage belong to this region.
One of those, Nigeria, requires particular attention, as it also ranks regarding the absolute forest area decrease in the top 5.

Concerns also raise regarding Brazil, which ranks in the top 5 with the most significant absolute forest area change from 1990 to 2016, 541,510 sq. km.

5. APPENDIX: SQL Queries Used

```
--- INITIALIZATION ---
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
  (SELECT forest_area.country_code,
          forest_area.year,
          forest_area.forest_area_sqkm,
          land_area.country_name,
          land_area.total_area_sq_mi,
          regions.region,
          regions.income_group,
          forest_area.forest_area_sqkm / (land_area.total_area_sq_mi * 2.59)
          * 100 forest_percentage,
          land_area.total_area_sq_mi * 2.59 total_area_sqkm
   FROM   forest_area
          JOIN land_area
            ON land_area.country_code = forest_area.country_code
               AND land_area.year = forest_area.year
          JOIN regions
            ON forest_area.country_code = regions.country_code);
```

```
--- GLOBAL SITUATION ---
--- creating subqueries for both years, the difference in sqkm and in percent, to
get one result for all four parameters for the first paragraph ---
WITH a1990
     AS (SELECT f.forest_area_sqkm AS world_1990_sqkm,
                f.year
         FROM   forestation f
         WHERE  f.country_name = 'World'
                AND f.year = 1990),
     a2016
     AS (SELECT f.forest_area_sqkm AS world_2016_sqkm,
                f.year
         FROM   forestation f
         WHERE  f.country_name = 'World'
                AND f.year = 2016),
     diffs
     AS (SELECT world_1990_sqkm,
```

```
               world_2016_sqkm,
               world_2016_sqkm - world_1990_sqkm
               diff_sqkm,
               ( world_2016_sqkm - world_1990_sqkm ) / world_1990_sqkm * 100 AS
                  diff_percent
        FROM   a2016,
               a1990)
SELECT world_1990_sqkm,
       world_2016_sqkm,
       diff_sqkm,
       Round(diff_percent :: NUMERIC, 2) AS diff_percent
FROM   diffs;
```

```
--- The query for the second paragraph. The values 1270000 and 1350000 are picked
as ranges from the difference of -1324449 between 1990 and 2016 ---
SELECT DISTINCT f.country_name,
               Round(f.total_area_sqkm :: NUMERIC, 2) AS peru_sqkm
FROM   forestation f
WHERE  f.total_area_sqkm BETWEEN 1270000 AND 1350000;
```

```
--- REGIONAL OUTLOOK ---
--- This query outputs the regions and designated forests in 1990 and 2016, ordered
by the highest difference in forestation between 1990 and 2016.  All the data to
fill in the table and extract the requested parameters are accessible ---
WITH r1990
     AS (SELECT f.region,
                Round(( SUM(f.forest_area_sqkm) * 100 / SUM(f.total_area_sqkm) )
                      ::
                      NUMERIC, 2)
                AS forest_percent_1990
         FROM   forestation f
         WHERE  f.year = 1990
         GROUP  BY f.region),
     r2016
     AS (SELECT f.region,
                Round(( SUM(f.forest_area_sqkm) * 100 / SUM(f.total_area_sqkm) )
                      ::
                      NUMERIC, 2)
                AS forest_percent_2016
         FROM   forestation f
         WHERE  f.year = 2016
         GROUP  BY f.region)
SELECT r1990.region,
```

```
       r1990.forest_percent_1990,
       r2016.forest_percent_2016,
       ( r2016.forest_percent_2016 - r1990.forest_percent_1990 ) AS diff_percent
FROM   r1990
       join r2016
         ON r1990.region = r2016.region
--- AND r1990.region = 'World'
--- NOTE: I uncomment the line above to reply to the first question regarding
global development. To get all data, I comment it out ---
ORDER  BY diff_percent ASC;
```

```
--- COUNTRY-LEVEL SUCCESS STORIES AND LARGEST CONCERNS ---
--- This query outputs the countries and region ordered by the highest increase of
forests, in order to find out the largest concerns please look at the note below
---
WITH c1990
     AS (SELECT f.country_name,
                f.region,
                Round(f.forest_area_sqkm :: NUMERIC, 2) AS forest_sqkm_1990
         FROM   forestation f
         WHERE  f.year = 1990),
     c2016
     AS (SELECT f.country_name,
                Round(f.forest_area_sqkm :: NUMERIC, 2) AS forest_sqkm_2016
         FROM   forestation f
         WHERE  f.year = 2016)
SELECT c1990.country_name,
       c1990.region,
       c1990.forest_sqkm_1990,
       c2016.forest_sqkm_2016,
       ( c2016.forest_sqkm_2016 - c1990.forest_sqkm_1990 ) AS forest_change_sqkm
FROM   c1990
       join c2016
         ON c1990.country_name = c2016.country_name
WHERE  c1990.forest_sqkm_1990 IS NOT NULL
       AND c2016.forest_sqkm_2016 IS NOT NULL
       AND c1990.country_name != 'World'
---ORDER BY forest_change_sqkm;
--- NOTE: by using the line above the results will be shown in ascending order,
which means they order the country and region with the highest decrease of forest
first ---
ORDER  BY forest_change_sqkm DESC;
```

```sql
--- COUNTRY-LEVEL SUCCESS STORIES AND LARGEST CONCERNS IN PERCENT ---
--- This query outputs the countries and regions ordered by the highest decrease of
forests in percent. In order to find out the highest increase of forests in percent
please look at the note below---
WITH c1990
     AS (SELECT f.country_name,
                f.region,
                Round (f.forest_area_sqkm :: NUMERIC, 2) AS forest_sqkm_1990,
                Round(( SUM(f.forest_area_sqkm) * 100 / SUM(f.total_area_sqkm) )
                      ::
                      NUMERIC, 2)
                                                         AS forest_percent_1990
         FROM   forestation f
         WHERE  f.year = 1990
         GROUP  BY 1,
                   2,
                   3),
     c2016
     AS (SELECT f.country_name,
                f.region,
                Round (f.forest_area_sqkm :: NUMERIC, 2) AS forest_sqkm_2016,
                Round(( SUM(f.forest_area_sqkm) * 100 / SUM(f.total_area_sqkm) )
                      ::
                      NUMERIC, 2)
                                                         AS forest_percent_2016
         FROM   forestation f
         WHERE  f.year = 2016
         GROUP  BY 1,
                   2,
                   3)
SELECT c1990.country_name,
       c1990.region,
       c1990.forest_percent_1990,
       c2016.forest_percent_2016,
       Round (( c2016.forest_sqkm_2016 - c1990.forest_sqkm_1990 ) /
              c1990.forest_sqkm_1990 *
                     100 :: NUMERIC, 2) AS diff_percent
FROM   c1990
       join c2016
         ON c1990.country_name = c2016.country_name
WHERE  c1990.forest_sqkm_1990 IS NOT NULL
       AND c2016.forest_sqkm_2016 IS NOT NULL
ORDER  BY diff_percent;
---ORDER  BY diff_percent DESC;
---NOTE: by using the line above the results will be shown in descending order,
which means the order of the country and region with the lowest decrease of forest
comes first ---
```

```sql
--- COUNTRY-LEVEL QUARTILES  ---
--- The query returns the number of countries grouped by forestation quartiles ---
WITH quartiles
     AS (SELECT f.country_name,
                f.forest_percentage,
                CASE
                  WHEN f.forest_percentage >= 75 THEN '75% - 100%'
                  WHEN f.forest_percentage >= 50 THEN '50% - 75%'
                  WHEN f.forest_percentage >= 25 THEN '25%-50%'
                  ELSE '0-25%'
                END AS quartiles
         FROM   forestation f
         WHERE  f.year = 2016
                AND f.forest_percentage IS NOT NULL
                AND f.country_name != 'World')
SELECT quartiles,
       Count(*)
FROM   quartiles
GROUP  BY quartiles
ORDER  BY quartiles;
```

```sql
-- COUNTRY-LEVEL QUARTILES  ---
--- The query returns the top quartile countries  ---
SELECT f.country_name,
       f.region,
       Round (f.forest_percentage :: NUMERIC, 2) AS designated_forest_percent
FROM   forestation f
WHERE  f.forest_percentage > 75
       AND f.forest_percentage <= 100
       AND f.year = 2016;
```