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** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9**, 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 **1279999.9891**).

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
Latin America & Caribbean	51.03	46.16
Sub-Saharan Africa	30.67	28.79
Europe & Central Asia	37.28	38.04
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.51
Middle East & North Africa	1.78	2.07
North America	35.65	36.04

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 **527229.06**. 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 **United 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	75.45
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 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 0-25% 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
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.90
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

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?*

As an analyst on the Forest Query team, I observed from my analysis that regions in the Sub-Saharan Africa have lost significant forest area percentage . Nigeria with an enormous amount of land per square kilometer has a 61.80 percentage decrease which is a huge concern on climate change and sustainability of the earth.

Countries in the Sub-Saharan Africa, East Asia & Pacific and Latin America & Caribbean emulate countries like the United States, China and Iceland by trying to increase their forest area and reduce deforestation. The world needs a susatainable environment and a well functioning ecosystem and forestation is a crucial way to achieve that.

APPENDIX: SQL QUERIES

1. GLOBAL SITUATION

```
DROP VIEW IF EXISTS forestation;

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

a. 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 Sum(forest_area_sqkm) AS forest_area_1990
FROM   forestation
WHERE  year = 1990
       AND country_name = 'World';
```

b. 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 Sum(forest_area_sqkm) AS forest_area_2016
FROM   forestation
WHERE  year = 2016
       AND country_name = 'World';
```

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
SELECT (SELECT Sum(forest_area_sqkm) AS forest_area_1990
        FROM   forestation
        WHERE  year = 1990
               AND country_name = 'World') - (SELECT
              Sum(forest_area_sqkm) AS forest_area_2016
                                               FROM   forestation
                                               WHERE  year = 2016
                                                      AND country
_name = 'World')
       AS
       forest_change;
```

d. What was the percent change in forest area of the world between 1990 and 2016?

```
WITH world_1990
     AS (SELECT country_name,
                forest_area_sqkm
         FROM   forestation
         WHERE  year = 1990
                AND region = 'World'),
     world_2016
     AS (SELECT country_name,
                forest_area_sqkm
         FROM   forestation
         WHERE  year = 2016
                AND region = 'World'),
     tab1
     AS (SELECT world_1990.country_name,
                world_1990.forest_area_sqkm     AS forest_1990,
                world_2016.forest_area_sqkm     AS forest_2016,
                ( ( world_2016.forest_area_sqkm -
                  world_1990.forest_area_sqkm ) * 100 /
                  world_1990.forest_area_sqkm ) AS percent_chang
e
         FROM   world_1990
```

```
                join world_2016
                  ON world_1990.country_name = world_2016.countr
y_name)
SELECT country_name,
       forest_1990,
       forest_2016,
       Round(percent_change :: NUMERIC, 2)
FROM   tab1;
```

e. 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?

```
SELECT country_name,
       total_area_sqkm,
       Abs(( total_area_sqkm ) - (SELECT (SELECT Sum(forest_area
_sqkm) AS
                                                 forest_area_199
0
                                          FROM   forestation
                                          WHERE  year = 1990
                                                 AND country_nam
e = 'World') -
                                             (SELECT Sum(forest_
area_sqkm) AS
                                                     forest_area
_2016
                                              FROM   forestation
                                              WHERE  year = 2016
                                                     AND country
_name = 'World'
                                             ) AS
                                         forest_change)) AS fore
st_area_diff
FROM   forestation
WHERE  year = 2016
ORDER  BY 3
LIMIT  1;
```

2. REGIONAL OUTLOOK

```
DROP VIEW IF EXISTS regions_percent_area;

CREATE VIEW regions_percent_area
AS
```

```
  SELECT r.region,
         la.year,
         Sum(fa.forest_area_sqkm)
              AS
            sum_forest_area_sqkm,
         Sum(la.total_area_sq_mi * 2.59)
              AS
            sum_total_area_sqkm,
         ( Sum(fa.forest_area_sqkm) / Sum(la.total_area_sq_mi *
2.59) ) * 100 AS
         percent_forest_region
  FROM   forest_area fa
         JOIN land_area la
           ON fa.country_code = la.country_code
              AND fa.year = la.year
         JOIN regions r
           ON la.country_code = la.country_code
  GROUP  BY 1,
            2
  ORDER  BY 1,
            2;
```

a. 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?

b. 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?

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

```
WITH forest_percentage_1990
     AS (SELECT region,
                ( SUM(forest_area_sqkm) * 100 / SUM(total_area_s
qkm) )
                   percentage_forest_1990
         FROM   forestation
         WHERE  year = 1990
         GROUP  BY 1),
     forest_percentage_2016
     AS (SELECT region,
                ( SUM(forest_area_sqkm) * 100 / SUM(total_area_s
qkm) )
                   percentage_forest_2016
         FROM   forestation
         WHERE  year = 2016
```

```
          GROUP  BY 1),
     joinded_1990_2016
     AS (SELECT *
         FROM   forest_percentage_1990
                join forest_percentage_2016 USING(region))
SELECT *,
       Round(( percentage_forest_1990 - percentage_forest_2016 )
 :: NUMERIC, 2)
       AS diff
FROM   joinded_1990_2016;
```

3. COUNTRY-LEVEL DETAIL

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 table_1990 AS
(
       SELECT country_code,
              country_name,
              year,
              forest_area_sqkm
       FROM   forest_area
       WHERE  year = 1990
       AND    forest_area_sqkm IS NOT NULL
       AND    country_name != 'World' ), table_2016 AS
(
       SELECT country_code,
              country_name,
              year,
              forest_area_sqkm
       FROM   forest_area
       WHERE  year = 2016
       AND    forest_area_sqkm IS NOT NULL
       AND    country_name != 'World' )
SELECT   table_1990.country_code,
         table_1990.country_name,
         r.region,
         table_1990.forest_area_sqkm
   AS forest_area_1990,
         table_2016.forest_area_sqkm
   AS forest_area_2016,
         table_1990.forest_area_sqkm - table_2016.forest_area_sq
km AS forest_change_sqkm
```

```
FROM      table_1990
JOIN      table_2016
ON        table_1990.country_code = table_2016.country_code
AND       (
                    table_1990.forest_area_sqkm IS NOT NULL
          AND       table_2016.forest_area_sqkm IS NOT NULL)
JOIN      regions r
ON        table_2016.country_code = r.country_code
ORDER BY 6 DESC 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 table_1990 AS
(
       SELECT country_code,
              country_name,
              year,
              forest_area_sqkm
       FROM   forest_area
       WHERE  year = 1990
       AND    forest_area_sqkm IS NOT NULL
       AND    country_name != 'World' ), table_2016 AS
(
       SELECT country_code,
              country_name,
              year,
              forest_area_sqkm
       FROM   forest_area
       WHERE  year = 2016
       AND    forest_area_sqkm IS NOT NULL
       AND    country_name != 'World' )
SELECT   table_1990.country_code,
         table_1990.country_name,
         r.region,
         table_1990.forest_area_sqkm
                                                                  AS
 forest_area_1990,
         table_2016.forest_area_sqkm
                                                                  AS
 forest_area_2016,
         table_1990.forest_area_sqkm - table_2016.forest_area_sq
km                                                                AS
 forest_change_sqkm,
         Abs(Round(((table_2016.forest_area_sqkm - table_1990.fo
rest_area_sqkm)/table_1990.forest_area_sqkm*100)::numeric,2)) AS
```

```
 percent_forest_change
FROM     table_1990
JOIN     table_2016
ON       table_1990.country_code = table_2016.country_code
AND      (
                  table_1990.forest_area_sqkm IS NOT NULL
         AND      table_2016.forest_area_sqkm IS NOT NULL)
JOIN     regions r
ON       table_2016.country_code = r.country_code
ORDER BY Round(((table_2016.forest_area_sqkm-
table_1990.forest_area_sqkm)/table_1990.forest_area_sqkm*100)::n
umeric,2) limit 5;
```

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

```
WITH tab1
     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,
                ( f.forest_area_sqkm / ( l.total_area_sq_mi * 2.
59 ) ) * 100 AS
                percent_forest_area
         FROM   forest_area f
                JOIN land_area l
                  ON f.country_code = l.country_code
                     AND ( f.country_name != 'World'
                           AND f.forest_area_sqkm IS NOT NULL
                           AND l.total_area_sq_mi IS NOT NULL )
                     AND ( f.year = 2016
                           AND l.year = 2016 )
         ORDER  BY 6 DESC),
     tab2
     AS (SELECT tab1.country_code,
                tab1.country_name,
                tab1.year,
                tab1.percent_forest_area,
                CASE
                  WHEN tab1.percent_forest_area >= 75 THEN 4
                  WHEN tab1.percent_forest_area < 75
                       AND tab1.percent_forest_area >= 50 THEN 3
                  WHEN tab1.percent_forest_area < 50
```

```
                      AND tab1.percent_forest_area >= 25 THEN 2
                  ELSE 1
                END AS percentile
         FROM   tab1
         ORDER  BY 5 DESC)
SELECT tab2.percentile,
       Count(tab2.percentile)
FROM   tab2
GROUP  BY 1
ORDER  BY 2 DESC;
```

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

```
WITH tab1
     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,
                ( f.forest_area_sqkm / ( l.total_area_sq_mi * 2.
59 ) ) * 100 AS
                percent_forest_area
         FROM   forest_area f
                JOIN land_area l
                  ON f.country_code = l.country_code
                     AND ( f.country_name != 'World'
                           AND f.forest_area_sqkm IS NOT NULL
                           AND l.total_area_sq_mi IS NOT NULL )
                     AND ( f.year = 2016
                           AND l.year = 2016 )
         ORDER  BY 6 DESC),
     tab2
     AS (SELECT tab1.country_code,
                tab1.country_name,
                tab1.year,
                tab1.percent_forest_area,
                CASE
                  WHEN tab1.percent_forest_area >= 75 THEN 4
                  WHEN tab1.percent_forest_area < 75
                       AND tab1.percent_forest_area >= 50 THEN 3
                  WHEN tab1.percent_forest_area < 50
                       AND tab1.percent_forest_area >= 25 THEN 2
                  ELSE 1
```

```
                END AS percentile
         FROM   tab1
         ORDER  BY 5 DESC)
SELECT tab2.country_name,
       r.region,
       Round(Cast(tab2.percent_forest_area AS NUMERIC), 2) AS
       percent_forest_area,
       tab2.percentile
FROM   tab2
       JOIN regions r
         ON tab2.country_code = r.country_code
WHERE  tab2.percentile = 4
ORDER  BY 1;
```

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

```
WITH tab1
     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,
                ( f.forest_area_sqkm / ( l.total_area_sq_mi * 2.
59 ) ) * 100 AS
                percent_forest_area
         FROM   forest_area f
                JOIN land_area l
                  ON f.country_code = l.country_code
                     AND ( f.country_name != 'World'
                           AND f.forest_area_sqkm IS NOT NULL
                           AND l.total_area_sq_mi IS NOT NULL )
                     AND ( f.year = 2016
                           AND l.year = 2016 )
         ORDER  BY 6 DESC)
SELECT Count(tab1.country_name)
FROM   tab1
WHERE  tab1.percent_forest_area > (SELECT tab1.percent_forest_ar
ea
                                   FROM   tab1
                                   WHERE  tab1.country_name = 'U
nited States')
```