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** sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9**sqkm, a loss of **1324449**sqkm, or **3.20824258980244**%.

The forest area lost over this time period is slightly more than the entire land area of **1279999.9891sqkm** listed for the year 2016 (which is **PERU**).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was **31.3755709643095**%. The region with the highest relative forestation was**Latin America & Caribbean**, with **48.35**%, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.93**% forestation.

In 1990, the percent of the total land area of the world designated as forest was **32.4222035575689**%. The region with the highest relative forestation was **Latin America & Caribbean**, with **48.27**%, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.93**% forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	**48.2691913515846**	**48.3459331391274**
Europe & Central Asia	**37.7149499747942**	**37.6010103797867**

North America	**35.7833776780377**	**35.8060157288054**
World	**31.8097661545749**	**31.8032285939027**
Sub-Saharan Africa	**29.5939305512368**	**29.592579216171**
East Asia & Pacific	**25.9526182999399**	**25.956135479964**
South Asia	**16.8775922195727**	**16.9066990228882**
Middle East & North Africa	**1.92554509651543**	**1.92601930378871**

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Europe & Central Asia** (dropped from **37.7149499747942**% to **37.6010103797867**%) and **Sub-Saharan Africa** (**29.5939305512368**% to **29.592579216171**%). 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 **31.8097661545749**% to **31.8032285939027**%.

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** sqkm. 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**sqkm, much lower than the figure for **China**.

Russian Federation and **China** 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 **213.664588870028**% 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 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
1	**85**
2	**73**
3	**38**
4	**9**

The largest number of countries in 2016 were found in the **1** 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**	**98.2576939676578**
Micronesia, Fed. Sts.	**East Asia & Pacific**	**91.8572390715248**
Gabon	**Sub-Saharan Africa**	**90.0376418700565**
Seychelles	**Sub-Saharan Africa**	**88.4111367385789**
Palau	**East Asia & Pacific**	**87.6068085491204**
American Samoa	**East Asia & Pacific**	**87.5000875000875**
Guyana	**Latin America & Caribbean**	**83.9014489110682**
Lao PDR	**East Asia & Pacific**	**82.1082317640861**
Solomon Islands	**East Asia & Pacific**	**77.8635177945066**

Number of countries that had percentage of forestation higher than United States in 2016 is **94**.

5. RECOMMENDATIONS

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

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

The total forest area of the world in 1990 was 41282694.9 sqkm. With the loss of 3.20824258980244%, the total forest area in 2016 had fallen to 39958245.9 sqkm. The forest area lost over this time period is slightly more than the entire land area of 1279999.9891sqkm listed for the year 2016, which is Peru. The number of countries that had a percentage of forestation higher than the United States in 2016 is 94. The only regions of the world that decreased in percent forest area from 1990 to 2016 were Europe & Central Asia (dropped from 37.7149499747942% to 37.6010103797867%) and Sub-Saharan Africa (29.5939305512368% to 29.592579216171%). 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 31.8097661545749% to 31.8032285939027%.

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

When we consider countries that decreased in forest area the most between 1990 and 2016, we find that the top 5 countries are Brazil, Indonesia, Myanmar, Nigeria, and Tanzania from the regions: Latin America and Caribbean, East Asia and Pacific, and Sub-Saharan Africa. 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 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 the 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. Russian Federation and China 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 213.664588870028% from 1990 to 2016.

6. APPENDIX- SQL QUERIES

TO CREATE A VIEW:

```
CREATE OR REPLACE VIEW forestation
AS
    SELECT f.country_code AS f_country_code,
                f.country_name AS f_country_name,
                f.year AS f_year,
                f.forest_area_sqkm AS f_forest_area_sqkm,
                l.total_area_sq_mi AS l_total_area_sq_mi,
                r.region AS r_region,
                r.income_group AS r_income_group,
               (f.forest_area_sqkm/(l.total_Area_sq_mi*2.59))*100 AS percent_land_area_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 l.country_code = r.country_code;
```

TO DROP A VIEW:

```
DROP VIEW forestation;
```

1.GLOBAL SITUATION:

TOTAL FOREST AREA OF THE WORLD IN 1990:

```
SELECT f_country_name,
      f_forest_area_sqkm,
      f_year
FROM forestation
WHERE f_country_name ='World' And f_year = 1990;
```

TOTAL FOREST AREA OF THE WORLD IN 2016:

```
SELECT f_country_name,
      f_forest_area_sqkm,
      f_year
FROM forestation
WHERE f_country_name ='World' And f_year = 2016;
```

DIFFERENCE OF FOREST AREA IN 1990 AND 2016:

```
SELECT (f1.forest_area_sqkm - f2.forest_area_sqkm) AS diff_forest_area_sqkm
FROM
          (SELECT f.country_name,
                      f.forest_area_sqkm
           FROM forest_area f
           WHERE f.country_name ='World' And f.year = 1990)AS f1
```

```
JOIN
        (SELECT f.country_name,
                f.forest_area_sqkm
         FROM forest_area f
         WHERE f.country_name ='World' And f.year = 2016) AS f2
ON (f1.country_name = f2.country_name) ;
```

PERCENTAGE DIFFERENCE OF FOREST AREA IN 1990 AND 2016:

```
SELECT ((f1.forest_area_sqkm - f2.forest_area_sqkm)/f1.forest_area_sqkm)*100 AS
diff_forest_area_sqkm
FROM
        (SELECT f.country_name,
        f.forest_area_sqkm
    FROM forest_area f
    WHERE f.country_name ='World' And f.year = 1990)AS f1
JOIN
   (SELECT f.country_name,
        f.forest_area_sqkm
    FROM forest_area f
    WHERE f.country_name ='World' And f.year = 2016) AS f2
ON (f1.country_name = f2.country_name) ;
```

FOREST AREA LOST IS SLIGHTLY MORE THAN COUNTRY LAND:

```
SELECT f_country_name,
          l_total_area_sq_mi*2.59 AS total_area_sqkm,
        ABS((l_total_area_sq_mi*2.59)-(SELECT (f1.forest_area_sqkm - f2.forest_area_sqkm)
                                        AS  diff_forest_area_sqkm
                                        FROM
                                            (SELECT f.country_name,
                                                    f.forest_area_sqkm
                                             FROM forest_area f
                                             WHERE f.country_name ='World' And f.year =
1990)AS f1
                                         JOIN
                                            (SELECT f.country_name,
                                                    f.forest_area_sqkm
                                             FROM forest_area f
                                             WHERE f.country_name ='World' And f.year =
2016) AS f2
                                        ON (f1.country_name = f2.country_name))) AS
diff_forest_area_sqkm
FROM forestation
WHERE f_year = 2016
ORDER BY 3
```

```
LIMIT 1;
```

2.REGIONAL OUTLOOK:

PERCENTAGE OF TOTAL LAND AREA OF WORLD DESIGNATED AS FOREST 2016:

```
SELECT f_forest_area_sqkm,
        l_total_area_sq_mi*2.59 AS sum_total_area,
        (f_forest_area_sqkm/(l_total_area_sq_mi*2.59))*100 AS perc_world_forest_area
FROM forestation
WHERE f_year=2016 AND f_country_name='World';
```

REGION WITH HIGHEST RELATIVE FOREST PERCENTAGE 2016:

```
SELECT f1.region,
        ROUND(CAST((SUM(f1.forest_area_sqkm)/SUM(f1.total_area_sqkm))*100 AS
NUMERIC),2) AS rel_reg_perc_forest_area
FROM
    (SELECT r.region AS region,
            r.country_name AS country_name,
            f.forest_area_sqkm AS forest_area_Sqkm,
            l.total_area_sq_mi*2.59 AS total_area_sqkm
     FROM regions r
    JOIN forest_area f
    ON r.country_code = f.country_code
    JOIN land_area l
    ON l.country_code = f.country_code
    WHERE l.year=2016)AS f1
GROUP BY 1
ORDER BY 2 DESC
LIMIT 1;
```

REGION WITH LOWEST RELATIVE FOREST PERCENTAGE 2016:

```
SELECT f1.region,
        ROUND(CAST((SUM(f1.forest_area_sqkm)/SUM(f1.total_area_sqkm))*100 AS
NUMERIC),2) AS rel_reg_perc_forest_area
FROM
    (SELECT r.region AS region,
            r.country_name AS country_name,
            f.forest_area_sqkm AS forest_area_Sqkm,
            l.total_area_sq_mi*2.59 AS total_area_sqkm
     FROM regions r
    JOIN forest_area f
    ON r.country_code = f.country_code
    JOIN land_area l
    ON l.country_code = f.country_code
```

```
        WHERE l.year=2016)AS f1
GROUP BY 1
ORDER BY 2 ASC
LIMIT 1;
```

PERCENTAGE OF TOTAL LAND AREA OF WORLD DESIGNATED AS FOREST 1990:

```
SELECT f_forest_area_sqkm,
           l_total_area_sq_mi*2.59 AS sum_total_area,
           (f_forest_area_sqkm/(l_total_area_sq_mi*2.59))*100 AS perc_world_forest_area
FROM forestation
WHERE f_year=1990 AND f_country_name='World';
```

REGION WITH HIGHEST RELATIVE FOREST PERCENTAGE 1990:

```
SELECT f1.region,
          ROUND(CAST((SUM(f1.forest_area_sqkm)/SUM(f1.total_area_sqkm))*100 AS
NUMERIC),2) AS rel_reg_perc_forest_area
FROM
        (SELECT r.region AS region,
                    r.country_name AS country_name,
                    f.forest_area_sqkm AS forest_area_sqkm,
                    l.total_area_sq_mi*2.59 AS total_area_sqkm
         FROM regions r
        JOIN forest_area f
        ON r.country_code = f.country_code
        JOIN land_area l
        ON l.country_code = f.country_code
        WHERE l.year=1990)AS f1
GROUP BY 1
ORDER BY 2 DESC
LIMIT 1;
```

REGION WITH LOWEST RELATIVE FOREST PERCENTAGE 1990:

```
SELECT f1.region,
          ROUND(CAST((SUM(f1.forest_area_sqkm)/SUM(f1.total_area_sqkm))*100 AS
NUMERIC),2) AS rel_reg_perc_forest_area
FROM
        (SELECT r.region AS region,
                    r.country_name AS country_name,
                    f.forest_area_sqkm AS forest_area_sqkm,
                    l.total_area_sq_mi*2.59 AS total_area_sqkm
         FROM regions r
        JOIN forest_area f
        ON r.country_code = f.country_code
```

```
        JOIN land_area l
        ON l.country_code = f.country_code
        WHERE l.year=1990)AS f1
GROUP BY 1
ORDER BY 2 ASC
LIMIT 1;
```

REGIONS DECREASED IN FOREST PERCENTAGE FROM 1990 TO 2016:

```
SELECT f3.region,
           f3.rel_reg_perc_forest_area AS rel_reg_perc_1990,
           f4.rel_reg_perc_forest_area AS rel_reg_perc_2016,
           (f3.rel_reg_perc_forest_area-f4.rel_reg_perc_forest_area)AS diff_forest_perc_area
FROM
          (SELECT f1.region AS region,
(SUM(f1.forest_area_sqkm)/SUM(f1.total_area_sqkm))*100 AS rel_reg_perc_forest_area
           FROM
                  (SELECT r.region AS region,
                             r.country_name AS country_name,
                             f.forest_area_sqkm AS forest_area_sqkm,
                             l.total_area_sq_mi*2.59 AS total_area_sqkm
                   FROM regions r
                  JOIN forest_area f
                  ON r.country_code = f.country_code
                  JOIN land_area l
                  ON l.country_code = f.country_code
                  WHERE l.year=1990)AS f1
          GROUP BY 1
          ORDER BY 2 DESC) AS f3

JOIN
         (SELECT f1.region AS region,
(SUM(f1.forest_area_sqkm)/SUM(f1.total_area_sqkm))*100 AS rel_reg_perc_forest_area
           FROM
                  (SELECT r.region AS region,
                             r.country_name AS country_name,
                         f.forest_area_sqkm AS forest_area_sqkm,
                         l.total_area_sq_mi*2.59 AS total_area_sqkm
                    FROM regions r
                   JOIN forest_area f
                   ON r.country_code = f.country_code
                   JOIN land_area l
                   ON l.country_code = f.country_code
                   WHERE l.year=2016)AS f1
          GROUP BY 1
```

```
        ORDER BY 2 DESC) AS f4
ON f3.region = f4.region
WHERE (f3.rel_reg_perc_forest_area - f4.rel_reg_perc_forest_area) > 0 ;
```

3.COUNTRY-LEVEL DETAIL:

A.SUCCESS STORIES:

COUNTRIES THAT HAS INCREASE FOREST AREA FROM 1990 TO 2016:

```
SELECT t1.f_country_name,
        (t2.f_forest_area_sqkm - t1.f_forest_area_sqkm) AS inc_forest_area
FROM
       (SELECT f_country_name,
               f_forest_area_sqkm
        FROM forestation
        WHERE f_year = 1990) AS t1
JOIN
      (SELECT f_country_name,
              f_forest_area_sqkm
       FROM forestation
       WHERE f_year = 2016) AS t2
ON t1.f_country_name = t2.f_country_name
WHERE t2.f_forest_area_sqkm > t1.f_forest_area_sqkm
ORDER BY 2 DESC
LIMIT 2;
```

COUNTRY AT TOP WITH HIGHEST PERCENTAGE OF FOREST AREA CHANGE FROM 1990 TO 2016:

```
SELECT f1.country_name ,
        ((f2.forest_area_sqkm - f1.forest_area_sqkm)/f1.forest_area_sqkm)*100 AS
diff_perc_forest_area_sqkm
FROM
      (SELECT f.country_name AS country_name,
              f.forest_area_sqkm
       FROM forest_area f
       WHERE f.year = 1990)AS f1
JOIN
     (SELECT f.country_name,
             f.forest_area_sqkm
      FROM forest_area f
      WHERE f.year = 2016) AS f2
ON (f1.country_name = f2.country_name)
WHERE (f2.forest_area_sqkm - f1.forest_area_sqkm)>0
ORDER BY 2 DESC
LIMIT 1;
```

B.LARGEST CONCERNS:

TOP 5 COUNTRIES WITH DECREASE IN ABSOLUTE FOREST AREA:

```
SELECT f1.f_country_name AS Country,
            F1.r_region AS Region,
            (f1.f_forest_area_sqkm - f2.f_forest_area_sqkm) AS Absolute_Forest_Area_Change
FROM (SELECT f_country_name, r_region,
                        f_forest_area_sqkm
            FROM forestation f
            WHERE f_year = 1990)AS f1
JOIN
          (SELECT f_country_name, r_region,
                      f_forest_area_sqkm
            FROM forestation f
            WHERE f_year = 2016) AS f2
ON (f1.f_country_name = f2.f_country_name)
WHERE (f1.f_forest_area_sqkm - f2.f_forest_area_sqkm) > 0
ORDER BY 3 DESC
LIMIT 6;
```

TOP 5 COUNTRIES WITH PERCENTAGE DECREASE IN FOREST AREA:

```
SELECT f1.f_country_name AS Country,
            f1.r_region AS Region,
            ROUND(CAST(((f1.f_forest_area_sqkm -
f2.f_forest_area_sqkm)/f1.f_forest_area_sqkm)*100 AS NUMERIC),2) AS
Pct_Forest_Area_Change
FROM (SELECT f_country_name, r_region,
                        f_forest_area_sqkm
            FROM forestation f
            WHERE f_year = 1990)AS f1
JOIN
          (SELECT f_country_name, r_region,
                      f_forest_area_sqkm
            FROM forestation f
            WHERE f_year = 2016) AS f2
ON (f1.f_country_name = f2.f_country_name)
WHERE (f1.f_forest_area_sqkm - f2.f_forest_area_sqkm) > 0
ORDER BY 3 DESC
LIMIT 5;
```

C.QUARTILES:

COUNT OF COUNTRIES GROUPED BY FORESTATION PERCENT QUARTILES 2016:

```
SELECT
    CASE WHEN percent_land_area_forest>=0 AND percent_land_area_forest<25 THEN 1
            WHEN percent_land_area_forest>=25 AND percent_land_area_forest<50 THEN 2
```

```
            WHEN percent_land_area_forest>=50 AND percent_land_area_forest<75 THEN 3
            WHEN percent_land_area_forest>=75 AND percent_land_area_forest<=100 THEN 4
    END AS quartile, COUNT(f_country_name)
FROM forestation
WHERE f_year = 2016 AND percent_land_area_forest IS NOT NULL
GROUP BY 1
ORDER BY 1;
```

COUNTRIES IN TOP QUARTILE IN 2016:

```
SELECT t1.f_country_name AS Country,
        t1.r_region AS Region,
        t1.percent_land_area_forest AS Pct_designated_As_forest
FROM
(SELECT
    CASE WHEN percent_land_area_forest>=0 AND percent_land_area_forest<25 THEN 1
            WHEN percent_land_area_forest>=25 AND percent_land_area_forest<50 THEN 2
        WHEN percent_land_area_forest>=50 AND percent_land_area_forest<75 THEN 3
        WHEN percent_land_area_forest>=75 AND percent_land_area_forest<=100 THEN 4
    END AS quartile, f_country_name, r_region, percent_land_area_forest
FROM forestation
WHERE f_year = 2016 AND percent_land_area_forest IS NOT NULL
GROUP BY 1,2,3,4
ORDER BY 4 DESC)AS t1
WHERE t1.quartile = 4;
```

NUMBER OF COUNTRIES HAD A PERCENTAGE FORESTATION HIGHER THAN UNITED STATES IN 2016:

```
SELECT COUNT(f_country_name)
FROM forestation
WHERE percent_land_area_forest >(SELECT percent_land_area_forest
                                 FROM forestation
                                 WHERE f_country_name = 'United States'
                                 AND f_year = 2016)
AND f_year = 2016;
```