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 km^2** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9km^2**, a loss of **1324449km**^{2}, or **3.208%.**

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 km^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.

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

Region	Forest Percentage 1990	Forest Percentage 2016
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 **527229.06 km^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 **79200 km^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 **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	541510.00
Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234.00
Nigeria	Sub-Saharan Africa	106506.00
Tanzania	Sub-Saharan Africa	102320.00

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	61.8
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**, and **Uganda**. 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:

Quartiles	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 **09** 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	87.5
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

4. RECOMMENDATIONS

1). What have I learned from the World Bank data?

During this 16 years (1990 to 2016) entire World has lost **3.2%** of forest area. It has been analyzed that we have lost the total forest area closer to land of Peru.

It has been observed that from 1990 to 2016, many regions' and countries' forest areas are increasing. Furthermore, when looking at the both figures of forest areas and percentage of forest areas, regions such as Europe & Central Asia, East Asia & Pacific, Middle East & North Africa, South Asia and North America are increasing. However, there is a significant shrinkage in countries like Togo, Nigeria, Uganda, Mauritania and Honduras where represents regions Sub – Saharan Africa and Latin America & Caribbean, according to percentages of forest area change. When considering the absolute forest area change in **km^2** s, Brazil, Indonesia, Myanmar, Nigeria and Tanzania have the highest declines.

On the other hand, the China, United States and Iceland etc, shows significant rise of forest areas during this time period (1990 to 2016). China has increased **527229.06 km^2** of forest zone while Iceland has increased its forest percentage by **213.66 %** from 1990 to 2016.

2). Which countries should we focus on over others?

It is recommended to focus on 5 countries that has highest decrease in forest area change, which are Brazil, Indonesia, Myanmar, Nigeria and Tanzania. It is also suggested to focus on Nigeria that what is happening there?, because Nigeria has included into both highest forest area change in **km^2** s and percentages of forest area change as country wise. I suggest to closer look at the best practices that China has implemented because their forest area has increased from 1990 to 2016 by **527229.06 km^2**.

5. APPENDIX: SQL Queries Used

SQL VIEW

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
(SELECT f.country_code AS forest_country_code,
f.country_name AS forest_country_name,
f.year AS f_year,
f.forest_area_sqkm AS forest_sq_km,
l.country_code AS land_country_code,
l.country_name AS land_country_name,
l.year AS l_year,
l.total_area_sq_mi *2.59 AS land_sq_km,
r.country_name AS region_country_name,
r.country_code AS region_country_code,
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_forrest_area
FROM forest_area AS f
JOIN land_area AS l
ON f.country_code = l.country_code AND f.year = l.year
JOIN regions AS r
ON r.country_code = l.country_code);
```

1. Global Situation

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 f_year,
       forest_sq_km,
       forest_country_name
FROM   forestation
WHERE  f_year = 1990
       AND forest_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 f_year,
       forest_sq_km,
       forest_country_name
FROM   forestation
WHERE  f_year = 2016
       AND forest_country_name = 'World';
```

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

```
WITH sub1
     AS (SELECT f_year,
                forest_sq_km,
                forest_country_code
         FROM   forestation
         WHERE  f_year = 1990
                AND forest_country_name = 'World'),
     sub2
     AS (SELECT f_year,
                forest_sq_km,
                forest_country_code
         FROM   forestation
         WHERE  f_year = 2016
                AND forest_country_name = 'World')
SELECT sub1.forest_sq_km - sub2.forest_sq_km AS diff_forest_sq_km
FROM   sub1
       JOIN sub2
         ON sub1.forest_country_code = sub2.forest_country_code;
```

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

```
WITH sub1
     AS (SELECT f_year,
                forest_sq_km,
                forest_country_code
         FROM   forestation
         WHERE  f_year = 1990
                AND forest_country_name = 'World'),
     sub2
     AS (SELECT f_year,
                forest_sq_km,
                forest_country_code
         FROM   forestation
         WHERE  f_year = 2016
                AND forest_country_name = 'World')
```

```
SELECT ( sub1.forest_sq_km - sub2.forest_sq_km ) / ( sub1.forest
_sq_km ) * 100
       AS
       per_change_forest
FROM   sub1
       JOIN sub2
         ON sub1.forest_country_code = sub2.forest_country_code;
```

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?

```
WITH sub1
AS
  (
         SELECT f_year,
                forest_sq_km,
                forest_country_code
         FROM   forestation
         WHERE  f_year = 1990
         AND    forest_country_name = 'World'),
  sub2
AS
  (
         SELECT f_year,
                forest_sq_km,
                forest_country_code
         FROM   forestation
         WHERE  f_year = 2016
         AND    forest_country_name = 'World')
  SELECT   land_country_name,
           land_sq_km,
           abs((land_sq_km) -
           (
                  SELECT sub1.forest_sq_km - sub2.forest_sq_km
                  FROM   sub1
                  JOIN   sub2
                  ON     sub1.forest_country_code = sub2.forest_countr
y_code)) AS diff_forest_area
  FROM     forestation
  WHERE    l_year = '2016'
  ORDER BY diff_forest_area

  LIMIT    1;
```

2. Regional Situation

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?

```
  SELECT r_region,
       f_year,
       Round(( ( Sum(forest_sq_km) / Sum(land_sq_km) ) * 100 ) :
: NUMERIC, 2) AS
       per_change_forest
FROM   forestation
WHERE  f_year = 2016
       AND r_region = 'World'
GROUP  BY r_region,
          f_year;
```

a.1.Which region had the HIGHEST percent forest in 2016, and which had the LOWEST, to 2 decimal places?

```
SELECT r_region,
       Round(( ( Sum(forest_sq_km) / Sum(land_sq_km) ) * 100 ) :
: NUMERIC, 2) AS
       per_change_forest
FROM   forestation
WHERE  f_year = 2016
GROUP  BY r_region
ORDER  BY per_change_forest DESC;
```

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?

```
SELECT r_region,
       f_year,
       Round(( ( Sum(forest_sq_km) / Sum(land_sq_km) ) * 100 ) :
: NUMERIC, 2) AS
       per_change_forest
FROM   forestation
WHERE  f_year = 1990
       AND r_region = 'World'
GROUP  BY r_region,
          f_year;
```

b.1. Which region had the HIGHEST percent forest in 1990, and which had the LOWEST, to 2 decimal places?

```
SELECT r_region,
       Round(( ( Sum(forest_sq_km) / Sum(land_sq_km) ) * 100 ) :
```

```
: NUMERIC, 2) AS
       per_change_forest
FROM   forestation
WHERE  f_year = 1990
GROUP  BY r_region
ORDER  BY per_change_forest DESC;
```

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 sub1
AS
  (
         SELECT forest_country_code,
                forest_country_name,
                r_region,
                forest_sq_km
         FROM   forestation
         WHERE  f_year = 1990
         AND    forest_sq_km IS NOT NULL
         AND    forest_country_name != 'World'),
  sub2
AS
  (
         SELECT forest_country_code,
                forest_country_name,
                r_region,
                forest_sq_km
         FROM   forestation
         WHERE  f_year = 2016
         AND    forest_sq_km IS NOT NULL
         AND    forest_country_name != 'World')
  SELECT   sub1.forest_country_code AS code,
           sub1.forest_country_name AS country,
           sub1.r_region,
           sub1.forest_sq_km                       AS forest_sq_
km_1990,
           sub2.forest_sq_km                       AS forest_sq_
km_2016,
           (sub1.forest_sq_km - sub2.forest_sq_km) AS diff_fores
t_sq_km
  FROM     sub1
  JOIN     sub2
  ON       sub1.forest_country_code = sub2.forest_country_code
  AND      sub1.forest_country_name = sub2.forest_country_name
  AND      (
```

```
                    sub1.forest_sq_km IS NOT NULL
          AND       sub2.forest_sq_km IS NOT NULL)
  ORDER BY diff_forest_sq_km 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 sub1
AS
  (
         SELECT forest_country_code,
                forest_country_name,
                r_region,
                forest_sq_km
         FROM   forestation
         WHERE  f_year = 1990
         AND    forest_sq_km IS NOT NULL
         AND    forest_country_name != 'World'),
  sub2
AS
  (
         SELECT forest_country_code,
                forest_country_name,
                r_region,
                forest_sq_km
         FROM   forestation
         WHERE  f_year = 2016
         AND    forest_sq_km IS NOT NULL
         AND    forest_country_name != 'World')
  SELECT   sub1.forest_country_code AS code,
           sub1.forest_country_name AS country,
           sub1.r_region,
           sub1.forest_sq_km
                                AS forest_sq_km_1990,
           sub2.forest_sq_km
                                AS forest_sq_km_2016,
           round(((sub1.forest_sq_km - sub2.forest_sq_km)/sub1.
forest_sq_km) *100)::NUMERIC,2) AS per_change_forest
  FROM     sub1
  JOIN     sub2
  ON       sub1.forest_country_code = sub2.forest_country_code
  AND      sub1.forest_country_name = sub2.forest_country_name
  AND      (
                    sub1.forest_sq_km IS NOT NULL
```

```
          AND      sub2.forest_sq_km IS NOT NULL)
  ORDER BY per_change_forest DESC
  LIMIT    5;
```

Success Story Analysis

```
WITH sub1
     AS (SELECT forest_country_code,
                forest_country_name,
                r_region,
                forest_sq_km
         FROM   forestation
         WHERE  f_year = 1990
                AND forest_sq_km IS NOT NULL
                AND forest_country_name != 'World'),
     sub2
     AS (SELECT forest_country_code,
                forest_country_name,
                r_region,
                forest_sq_km
         FROM   forestation
         WHERE  f_year = 2016
                AND forest_sq_km IS NOT NULL
                AND forest_country_name != 'World')
SELECT sub1.forest_country_code                    AS code,
       sub1.forest_country_name                    AS Country,
       sub1.r_region,
       sub1.forest_sq_km                           AS forest_sq_km
_1990,
       sub2.forest_sq_km                           AS forest_sq_km
_2016,
       ( sub1.forest_sq_km - sub2.forest_sq_km ) AS diff_forest_
sq_km,
       Round(( ( ( sub1.forest_sq_km - sub2.forest_sq_km ) / sub
1.forest_sq_km )
               * 100
             ) ::
             NUMERIC, 2)                           AS per_change_f
orest
FROM   sub1
       join sub2
         ON sub1.forest_country_code = sub2.forest_country_code
            AND sub1.forest_country_name = sub2.forest_country_n
ame
            AND ( sub1.forest_sq_km IS NOT NULL
```

```
                    AND sub2.forest_sq_km IS NOT NULL )
ORDER  BY per_change_forest DESC;
```

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

```
WITH t1
     AS (SELECT forest_country_code,
                forest_country_name,
                r_region,
                f_year,
                forest_sq_km,
                percent_forrest_area
         FROM   forestation
         WHERE  f_year = 2016
                AND ( forest_sq_km IS NOT NULL
                      AND land_sq_km IS NOT NULL )
                AND forest_country_name != 'World'
         ORDER  BY percent_forrest_area DESC),
     t2
     AS (SELECT t1.forest_country_code,
                t1.forest_country_name,
                t1.r_region,
                t1.f_year,
                t1.forest_sq_km,
                t1.percent_forrest_area,
                CASE
                  WHEN t1.percent_forrest_area >= 75 THEN '75% -
 100%'
                  WHEN t1.percent_forrest_area >= 50 THEN '50% -
 75%'
                  WHEN t1.percent_forrest_area >= 25 THEN '25% -
50%'
                  ELSE '0-25%'
                END AS quartiles
         FROM   t1
         ORDER  BY quartiles DESC)
SELECT t2.quartiles,
       Count(*)
FROM   t2
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 t1
     AS (SELECT forest_country_code,
                forest_country_name,
                r_region,
                f_year,
                forest_sq_km,
                percent_forrest_area
         FROM   forestation
         WHERE  f_year = 2016
                AND ( forest_sq_km IS NOT NULL
                      AND land_sq_km IS NOT NULL )
                AND forest_country_name != 'World'
         ORDER  BY percent_forrest_area DESC),
     t2
     AS (SELECT t1.forest_country_code,
                t1.forest_country_name,
                t1.r_region,
                t1.f_year,
                t1.forest_sq_km,
                t1.percent_forrest_area,
                CASE
                  WHEN t1.percent_forrest_area >= 75 THEN '75% -
 100%'
                  WHEN t1.percent_forrest_area >= 50 THEN '50% -
 75%'
                  WHEN t1.percent_forrest_area >= 25 THEN '25% -
50%'
                  ELSE '0-25%'
                END AS quartiles
         FROM   t1
         ORDER  BY quartiles DESC)
SELECT t2.forest_country_code,
       t2.forest_country_name,
       t2.r_region,
       Round(Cast(t2.percent_forrest_area AS NUMERIC), 2) AS
       percent_forrest_area
FROM   t1
       JOIN t2
         ON t1.forest_country_code = t2.forest_country_code
            AND t1.forest_country_name = t2.forest_country_name
WHERE  t2.percent_forrest_area >= 75
ORDER  BY percent_forrest_area DESC;
```

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

```
WITH t1
     AS (SELECT forest_country_code,
                forest_country_name,
                r_region,
                f_year,
                forest_sq_km,
                percent_forrest_area
         FROM   forestation
         WHERE  f_year = 2016
                AND ( forest_sq_km IS NOT NULL
                      AND land_sq_km IS NOT NULL )
                AND forest_country_name != 'World'
         ORDER  BY percent_forrest_area DESC)
SELECT Count(t1.forest_country_name)
FROM   t1
WHERE  t1.percent_forrest_area > (SELECT t1.percent_forrest
_area
                                  FROM   t1
                                  WHERE
       t1.forest_country_name = 'United States');
```