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 and Carribean**, 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 **51.08**%, 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
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 percentage 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 **527,229.07 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 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 **213.04**% 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	106506.001
Tanzania	Sub-Saharan Africa	102320

The second way to consider which countries are of concern is to analyze the data by percent decrease.

Country	Region	Pct Forest Area Change
Benin	Sub-Saharan Africa	15000

Angola	Sub-Saharan Africa	32448.0078
Burundi	Sub-Saharan Africa	83.999939
Botswana	Sub-Saharan Africa	29802.002
Burkina Faso	Sub-Saharan Africa	15567.99805

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

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 **Benin, Angola, Burundi** and **Botswana.** The 5th country on the list is Burkina Faso, which is in the **Sub-Saharan Africa** region.

From the above analysis, we see that _____ 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
4	9
1	85
3	38
2	72

The largest number of countries in 2016 were found in the **1st** 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	87.5
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.9
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
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?*
    - *The world as a whole lost 3.21% of its land to deforestation.*
    - *The region responsible for this decrease seems to be focused in the Sub-Sahara African region, going from 30.67% to 28.79%.*
- *Which countries should we focus on over others?*
    - *We should focus on the areas with the most decrease in forest area which was these countries:*

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	106506.001
Tanzania	Sub-Saharan Africa	102320

    -

GLOBAL SITUATION

Create View

```
CREATE VIEW forestation
AS
  SELECT f.country_code,
         f.country_name,
         f.year,
         f.forest_area_sqkm,
         l.total_area_sq_mi,
         r.region,
         r.income_group,
         ( f.forest_area_sqkm / ( l.total_area_sq_mi * 2.59 ) ) * 100
AS
            perc_forest_area
  FROM   forest_area f
         join land_area l
           ON f.country_code = l.country_code
         join regions r
           ON l.country_code = r.country_code
  WHERE  f.year = l.year
  ORDER  BY 1;
```

1. 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.forest_area_sqkm
FROM   forest_area f
WHERE  f.country_name = 'World'
       AND f.year = 1990;
```

2. 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.forest_area_sqkm
FROM   forest_area f
WHERE  f.country_name = 'World'
       AND f.year = 2016;
```

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

```
SELECT sub1.forest_area_sqkm - sub2.forest_area_sqkm AS diff_forest_
area_sq_km
FROM   (SELECT f.country_code AS cc,
               f.forest_area_sqkm
        FROM   forest_area f
        WHERE  f.country_name = 'World'
               AND f.year = 1990) AS sub1
```

```
        JOIN (SELECT f.country_code AS cc,
                     f.forest_area_sqkm
              FROM   forest_area f
              WHERE  f.country_name = 'World'
                     AND f.year = 2016) AS sub2
          ON sub1.cc = sub2.cc;
```

Percentage

```
SELECT
( ( sub1.forest_area_sqkm - sub2.forest_area_sqkm ) / sub1.forest
_area_sqkm ) * 100 AS perc_change_fa
FROM   (SELECT f.country_code AS cc,
               f.forest_area_sqkm
        FROM   forest_area f
        WHERE  f.country_name = 'World'
               AND f.year = 1990) AS sub1
       JOIN (SELECT f.country_code AS cc,
                    f.forest_area_sqkm
             FROM   forest_area f
             WHERE  f.country_name = 'World'
                    AND f.year = 2016) AS sub2
         ON sub1.cc = sub2.cc;
```

4. 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 l.country_name,
       l.total_area_sq_mi * 2.59
         AS
       total_area_sqkm,
       Abs(( l.total_area_sq_mi * 2.59 ) - (SELECT
           sub1.forest_area_sqkm - sub2.forest_area_sqkm AS
           diff_forest_area_sq_km
                                            FROM
           (SELECT f.country_code AS cc,
                   f.forest_area_sqkm
            FROM   forest_area f
            WHERE  f.country_name =
                   'World'
                   AND f.year = 1990) AS sub1
           JOIN (SELECT f.country_code AS cc,
                        f.forest_area_sqkm
                 FROM   forest_area f
                 WHERE  f.country_name =
                        'World'
                        AND f.year = 2016) AS
                sub2
```

```
            ON sub1.cc = sub2.cc)) AS
       diff_fa_la_sqkm
FROM   land_area l
WHERE  l.year = 2016
ORDER  BY 3
LIMIT  1;
```

REGIONAL OUTLOOK

a. Create a table that shows the Regions and their percent forest area (sum of forest area divided by sum of land area) in 1990 and 2016. (Note that 1 sq mi = 2.59 sq km).

```
CREATE VIEW regional_distr
AS
  SELECT r.region,
         l.year,
         SUM(f.forest_area_sqkm)
            total_forest_area_sqkm,
         SUM(l.total_area_sq_mi * 2.59)
           AS
            total_area_sqkm,
         ( SUM(f.forest_area_sqkm) / SUM(l.total_area_sq_mi * 2.5
9) ) * 100 AS
           percent_fa_region
  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
  GROUP  BY 1,
            2
  ORDER  BY 1,
            2;
```

b. 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?

2016 Percent Forest

```
SELECT Round(Cast(percent_fa_region AS NUMERIC), 2) AS percent_fa
_region
FROM   regional_distr
WHERE  year = 2016
       AND region = 'World';
```

Highest

```
SELECT region,
       Round(Cast(total_area_sqkm AS NUMERIC), 2)   AS total_area
_sqkm,
       Round(Cast(percent_fa_region AS NUMERIC), 2) AS percent_fa
_region
FROM   regional_distr
WHERE  Round(Cast(percent_fa_region AS NUMERIC), 2) = (SELECT
```

```
                Max(
                Round(Cast(percent_fa_region
                           AS NUMERIC), 2))
                AS max_percent
                                                    FROM   reg
ional_distr
                                                    WHERE  yea
r = 2016)
       AND year = 2016;
```

Lowest

```
SELECT region,
       Round(Cast(total_area_sqkm AS NUMERIC), 2)   AS total_area
_sqkm,
       Round(Cast(percent_fa_region AS NUMERIC), 2) AS percent_fa
_region
FROM   regional_distr
WHERE  Round(Cast(percent_fa_region AS NUMERIC), 2) = (SELECT
                Min(
                Round(Cast(percent_fa_region
                           AS NUMERIC), 2))
                AS max_percent
                                                    FROM   reg
ional_distr
                                                    WHERE  yea
r = 2016)
       AND year = 2016;
```

c. 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?

1990 Percentage Forest

```
SELECT Round(Cast(percent_fa_region AS NUMERIC), 2) AS percent_fa
_region
FROM   regional_distr
WHERE  year = 1990
       AND region = 'World';
```

Highest

```
SELECT region,
       Round(Cast(total_area_sqkm AS NUMERIC), 2)   AS total_area
_sqkm,
       Round(Cast(percent_fa_region AS NUMERIC), 2) AS percent_fa
_region
FROM   regional_distr
WHERE  Round(Cast(percent_fa_region AS NUMERIC), 2) = (SELECT
                Max(
```

```
                    Round(Cast(percent_fa_region
                               AS NUMERIC), 2))
                    AS max_percent
                                                          FROM   reg
    ional_distr
                                                          WHERE  yea
    r = 1990)
           AND year = 1990;
```

Lowest

```
    SELECT region,
      Round(Cast(total_area_sqkm AS NUMERIC), 2)   AS total_area_sqkm
,
      Round(Cast(percent_fa_region AS NUMERIC), 2) AS percent_fa_regi
on
FROM   regional_distr
WHERE  Round(Cast(percent_fa_region AS NUMERIC), 2) = (SELECT
             Min(
             Round(Cast(percent_fa_region
                        AS NUMERIC), 2))
             AS max_percent
                                                    FROM   regional
_distr
                                                    WHERE  year = 1
990)
       AND year = 1990;
```

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

```
WITH table1990
     AS (SELECT *
         FROM   regional_distr
         WHERE  year = 1990),
     table2016
     AS (SELECT *
         FROM   regional_distr
         WHERE  year = 2016)
SELECT table1990.region,
       Round(Cast(table1990.percent_fa_region AS NUMERIC), 2) AS fa_
1990,
       Round(Cast(table2016.percent_fa_region AS NUMERIC), 2) AS fa_
2016
FROM   table1990
       JOIN table2016
```

```
          ON table1990.region = table2016.region
WHERE  table1990.percent_fa_region > table2016.percent_fa_region;
```

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 table1990 AS
(
       SELECT f.country_code,
              f.country_name,
              f.year,
              f.forest_area_sqkm
       FROM   forest_area f
       WHERE  f.year = 1990
       AND    f.forest_area_sqkm IS NOT NULL
       AND    f.country_name != 'World' ), table2016 AS
(
       SELECT f.country_code,
              f.country_name,
              f.year,
              f.forest_area_sqkm
       FROM   forest_area f
       WHERE  f.year = 2016
       AND    f.forest_area_sqkm IS NOT NULL
       AND    f.country_name != 'World' )
SELECT   table1990.country_code,
         table1990.country_name,
         r.region,
         table1990.forest_area_sqkm                                AS fa_1
990_sqkm,
         table2016.forest_area_sqkm                                AS fa_2
016_sqkm,
         table1990.forest_area_sqkm-
table2016.forest_area_sqkm AS diff_fa_sqkm
FROM     table1990
JOIN     table2016
ON       table1990.country_code = table2016.country_code
AND      (
                  table1990.forest_area_sqkm IS NOT NULL
         AND      table2016.forest_area_sqkm IS NOT NULL)
JOIN     regions r
ON       table2016.country_code = r.country_code
ORDER BY 3 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 table1
     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
                perc_fa
         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),
     table2
     AS (SELECT table1.country_code,
                table1.country_name,
                table1.year,
                table1.perc_fa,
                CASE
                  WHEN table1.perc_fa >= 75 THEN 4
                  WHEN table1.perc_fa < 75
                       AND table1.perc_fa >= 50 THEN 3
                  WHEN table1.perc_fa < 50
                       AND table1.perc_fa >= 25 THEN 2
                  ELSE 1
                END AS percentile
         FROM   table1
         ORDER  BY 5 DESC)
SELECT table2.percentile,
       Count(table2.percentile)
FROM   table2
ORDER BY 3 DESC limit 5;
```

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

```
WITH table1
     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
                 perc_fa
          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),
     table2
     AS (SELECT table1.country_code,
                table1.country_name,
                table1.year,
                table1.perc_fa,
                `
                  WHEN table1.perc_fa >= 75 THEN 4
                  WHEN table1.perc_fa < 75
                       AND table1.perc_fa >= 50 THEN 3
                  WHEN table1.perc_fa < 50
                       AND table1.perc_fa >= 25 THEN 2
                  ELSE 1
                END AS percentile
          FROM   table1
          ORDER  BY 5 DESC)
SELECT table2.percentile,
       Count(table2.percentile)
FROM   table2
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 table1
     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
                perc_fa
         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),
     table2
     AS (SELECT table1.country_code,
                table1.country_name,
                table1.year,
                table1.perc_fa,
                CASE
                  WHEN table1.perc_fa >= 75 THEN 4
                  WHEN table1.perc_fa < 75
                       AND table1.perc_fa >= 50 THEN 3
                  WHEN table1.perc_fa < 50
                       AND table1.perc_fa >= 25 THEN 2
                  ELSE 1
                END AS percentile
         FROM   table1
         ORDER  BY 5 DESC)
SELECT table2.country_name,
       r.region,
       Round(Cast(table2.perc_fa AS NUMERIC), 2) AS perc_fa,
       table2.percentile
FROM   table2
       JOIN regions r
         ON table2.country_code = r.country_code
WHERE  table2.percentile = 4
ORDER  BY 1;
```

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

```
WITH table1
     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
                perc_fa
         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(table1.country_name)
FROM   table1
WHERE  table1.perc_fa > (SELECT table1.perc_fa
                         FROM   table1
                         WHERE  table1.country_name = 'United States')
```