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 1324449 km^2, or 3.2%.

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 1279999km^2).

2. **REGIONAL OUTLOOK**

In 2016, the percentage of the total land area of the world designated as forest was 31.38%. The region with the highest relative forestation was Latin America & Central Caribbean, with 46.16%, and the region with the lowest relative forestation was Middle East & North Africa, with 2.07% forestation.

In 1990, the percentage of the total land area of the world designated as forest was 32.42. The region with the highest relative forestation was Latin America & Central 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
Europa & Central Asia	37.28	38.04
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 & Central 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 it's forest area from 1990 to 2016 by 527229.062 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 the US 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 it's forest area by 31.9% 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 in km^2
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	-59.27
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, Ugandaand 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 1st quartile.

There were 85 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

PROJECT CODE

CREATE VIEW

```
CREATE VIEW Forestation AS
        SELECT r.country_name,
            f.year,
                r.income_group,
                r.region,
                l.total_area_sq_mi,
                f.forest_area_sqkm,
```

```
                ((Sum(forest_area_sqkm)/Sum(total_area_sq_mi*2.59))*100) percentage_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 r.country_code = f.country_code
GROUP BY r.country_name,
 f.year,
 r.income_group,
 r.region,
 l.total_area_sq_mi,
 F.forest_area_sqkm
```

1a 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 country_name, forest_area_sqkm
FROM forestation
WHERE country_name='World' AND year=1990 1b  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 country_name, forest_area_sqkm
FROM forestation
WHERE country_name='World' AND year=2016
```

1c What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
WITH t1 AS (
  SELECT SUM(forest_area_sqkm) sum_1990
  FROM forestation
  WHERE country_name='World' AND year=1990),
        t2 AS (
  SELECT SUM(forest_area_sqkm) sum_2016
  FROM forestation
  WHERE country_name='World' AND year=2016)
SELECT (sum_1990 - sum_2016) diff
FROM t1,t2
```

1d What was the percent change in forest area of the world between 1990 and 2016?

```
SELECT (diff/sum_1990)*100 diff_procent
FROM (
WITH t1 AS (
                SELECT SUM(forest_area_sqkm) sum_1990
                FROM forestation
```

```
        WHERE country_name='World' AND year=1990),
    t2 AS (
        SELECT SUM(forest_area_sqkm) sum_2016
        FROM forestation
        WHERE country_name='World' AND year=2016)
SELECT (sum_1990 - sum_2016) diff, sum_1990
FROM t1,t2) t3
```

1 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?

```
-- use the query from before (1c) to solve this one
-- then check which area is closest to that
SELECT *
FROM (
WITH t1 AS (
  SELECT SUM(forest_area_sqkm) sum_1990
  FROM forestation
  WHERE country_name='World' AND year=1990),
    t2 AS (
  SELECT SUM(forest_area_sqkm) sum_2016
  FROM forestation
  WHERE country_name='World' AND year=2016),
    x1 AS (
    SELECT country_name, total_area_sq_mi*2.59 total_area_sqkm
    FROM forestation
    WHERE year = 2016 AND total_area_sq_mi IS NOT NULL
    ORDER BY 2 DESC)

SELECT (sum_1990 - sum_2016) diff, x1.country_name, total_area_sqkm
FROM t1, t2, x1
)c1
ORDER BY ABS(total_area_sqkm- diff)
LIMIT 1
```

2a In 2016, the percent of the total land area of the world designated as forest was 31.38%.

```
SELECT percentage_forest
total_area_sqkm
FROM forestation
WHERE year = 2016 AND country_name = 'World'
```

2b The region with the highest relative forestation was Latin America & Central Caribbean, with 46.16%

```
SELECT      region,
            SUM(forest_area_sqkm) /
            (SUM(total_area_sq_mi)*2.59) *100
        procentage_forest
FROM forestation
WHERE year = 2016
GROUP BY 1
ORDER BY 2 DESC
LIMIT 1
```

2c and the region with the lowest relative forestation was Middle East & North Africa, with 2.07% forestation.

```
SELECT      region,
            SUM(forest_area_sqkm) /
            (SUM(total_area_sq_mi)*2.59) *100
        procentage_forest
FROM forestation
WHERE year = 2016
GROUP BY 1
ORDER BY 2 ASC
LIMIT 1
```

2d In 1990, the percentage of the total land area of the world designated as forest was 32.42. The region with the highest relative forestation was Latin America & Central Caribbean, with 51.03%

```
SELECT      region,
            SUM(forest_area_sqkm) /
            (SUM(total_area_sq_mi)*2.59) *100
        procentage_forest
FROM forestation
WHERE year = 1990
GROUP BY 1
ORDER BY 2 DESC
LIMIT 1
```

2e and the region with the lowest relative forestation was Middle East & North Africa, with 1.78% forestation.

```
SELECT      region,
```

```
                SUM(forest_area_sqkm) /
                (SUM(total_area_sq_mi)*2.59) *100
        procentage_forest
FROM forestation
WHERE year = 1990
GROUP BY 1
ORDER BY 2 ASC
LIMIT 1
```

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

```
SELECT      region,
                SUM(forest_area_sqkm) /
                (SUM(total_area_sq_mi)*2.59) *100
        procentage_forest
FROM forestation
WHERE year = 1990
GROUP BY 1
ORDER BY 2 DESC

-- New Query. Run both and find the values --
SELECT      region,
                SUM(forest_area_sqkm) /
                (SUM(total_area_sq_mi)*2.59) *100
        procentage_forest
FROM forestation
WHERE year = 2016
GROUP BY 1
ORDER BY 2 DESC
```

3a 1) There is one particularly bright spot in the data at the country level, China. This country actually increased it's forest area from 1990 to 2016 by 527229.062 km^2.

```
SELECT country_name, (forest_area_2016 - forest_area_1990) max_diff
FROM (
WITH x1 AS (
  SELECT      country_name, year,
                    SUM(forest_area_sqkm) forest_area_1990
  FROM forestation
  WHERE YEAR = 1990 AND forest_area_sqkm IS NOT NULL
  GROUP BY country_name, forest_area_sqkm, year
  ORDER BY forest_area_1990 DESC ),
  x2 AS (
        SELECT country_name, year,
```

```
                SUM(forest_area_sqkm) forest_area_2016
        FROM forestation
        WHERE YEAR = 2016 AND forest_area_sqkm IS NOT NULL
        GROUP BY country_name, forest_area_sqkm, year
        ORDER BY forest_area_2016 DESC )
SELECT x1.country_name, x1.year, x1.forest_area_1990, x2.forest_area_2016
FROM x1
JOIN x2
ON x1.country_name = x2.country_name
)t1
ORDER BY 2 DESC
LIMIT 1;
```

3a 2) China and the US 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 it's forest area by 31.9% from 1990 to 2016.

```
WITH x1 AS (
        SELECT      country_name, year,
                    SUM(forest_area_sqkm) /
                    SUM(total_area_sq_mi*2.59)*100
                            forest_area_1990
 FROM forestation
 WHERE YEAR = 1990 AND forest_area_sqkm IS NOT NULL
 GROUP BY   country_name,
                    forest_area_sqkm,
                    year
),

 x2 AS (
         SELECT country_name, year,
                    SUM(forest_area_sqkm) /
                    SUM(total_area_sq_mi*2.59)*100
                            forest_area_2016
        FROM forestation
        WHERE YEAR = 2016 AND forest_area_sqkm IS NOT NULL
        GROUP BY    country_name,
                            forest_area_sqkm,
                            year
)
```

```
SELECT x1.country_name, x1.year, x1.forest_area_1990, x2.forest_area_2016,
(x1.forest_area_1990/x2.forest_area_2016)*100 pro_change
FROM x1
JOIN x2
ON x1.country_name = x2.country_name
ORDER BY pro_change
LIMIT 1
```

3b 1) Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

```
SELECT country_name, region, (forest_area_2016 - forest_area_1990) max_diff
FROM (
WITH x1 AS (
  SELECT       country_name, region, year,
                        SUM(forest_area_sqkm) forest_area_1990
  FROM forestation
  WHERE YEAR = 1990 AND forest_area_sqkm IS NOT NULL
  GROUP BY country_name, region, forest_area_sqkm, year
  ORDER BY forest_area_1990 DESC ),
  x2 AS (
          SELECT country_name, region, year,
                SUM(forest_area_sqkm) forest_area_2016
        FROM forestation
        WHERE YEAR = 2016 AND forest_area_sqkm IS NOT NULL
        GROUP BY country_name, region, forest_area_sqkm, year
        ORDER BY forest_area_2016 DESC )
SELECT x1.country_name, x1.region, x1.year, x1.forest_area_1990, x2.forest_area_2016
FROM x1
JOIN x2
ON x1.country_name = x2.country_name
)t1
WHERE country_name != 'World'
ORDER BY 3 ASC
LIMIT 5
```

3b 2) Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

```
WITH x1 AS (
        SELECT        country_name,
                      region,
                      year,
                      SUM(forest_area_sqkm) /
                      SUM(total_area_sq_mi*2.59)*100
                            forest_area_1990
```

```
 FROM forestation
 WHERE YEAR = 1990 AND forest_area_sqkm IS NOT NULL
 GROUP BY   country_name,
                        region,
                        forest_area_sqkm,
                        year ),

 x2 AS (
         SELECT country_name,
                        region,
                        year,
                        SUM(forest_area_sqkm) /
                        SUM(total_area_sq_mi*2.59)*100
                                forest_area_2016
        FROM forestation
        WHERE YEAR = 2016 AND forest_area_sqkm IS NOT NULL
        GROUP BY    country_name,
                                region,
                                forest_area_sqkm,
                                year )

SELECT        x1.country_name,
              x1.region,
              x1.forest_area_1990,
              x2.forest_area_2016,
CAST(((x1.forest_area_1990-x2.forest_area_2016)/x1.forest_area_1990 * 100) AS
DECIMAL(10,2)) procent_diff
FROM x1
JOIN x2
ON x1.country_name = x2.country_name
WHERE x1.country_name != 'World' AND x2.country_name != 'World' AND
x1.forest_area_1990 IS NOT NULL
ORDER BY procent_diff DESC
LIMIT 5;
```

3 3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

```
WITH x1 AS (
 SELECT       country_name,percentage_forest,
       YEAR,
       (SUM(forest_area_sqkm) /
       SUM(total_area_sq_mi*2.59))
       * 100 perc_forestation
```

```
  FROM forestation
  WHERE YEAR = 2016
  GROUP BY   country_name,
             YEAR,
             forest_area_sqkm )
SELECT DISTINCT    viertel, country_name, percentage_forest,
          COUNT(country_name) OVER(PARTITION BY viertel)
FROM (
          SELECT country_name,
          CASE
          WHEN perc_forestation<25 THEN '0-25'
          WHEN perc_forestation>=25
          AND perc_forestation<50 THEN '25-50'
          WHEN perc_forestation>=50
          AND perc_forestation<75 THEN '50-75'
          ELSE '75-100'
          END AS viertel
          FROM x1
          WHERE perc_forestation IS NOT NULL
          AND YEAR = 2016 ) t1
          WHERE viertel = '0-25'
```

3.4: Top Quartile Countries, 2016:

```
WITH t2 AS
          (WITH t1 AS
                    (SELECT       country_name,
                                        YEAR,
                                        region,
                                        (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))
                                                  *100 percent_forestation
                    FROM forestation
                    WHERE YEAR = 2016
                    GROUP BY    country_name,
                                        YEAR,
                                        region,
                                        forest_area_sqkm)
                  ---------------------------------------------
          SELECT Distinct(viertel),
                                        count(country_name)Over(PARTITION BY viertel),
                                        country_name,
                                        region,
                                        percent_forestation
```

```
        FROM
        (SELECT       country_name,
                              region,
                              percent_forestation,
        CASE WHEN percent_forestation<=25 THEN '0-25'
        WHEN percent_forestation>25
        AND percent_forestation<=50 THEN '25-50'
        WHEN percent_forestation>50
        AND percent_forestation<=75 THEN '50-75'
        ELSE '75-100'
        END AS viertel
        FROM t1
        WHERE percent_forestation IS NOT NULL
        AND YEAR = 2016) y)
SELECT        country_name,
              region,
              percent_forestation
FROM t2
WHERE viertel = '75-100'
ORDER BY percent_forestation DESC
```