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 1,279,999.9891 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 & Caribbean, with 46.14%, 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	51.08	46.14
Europe & Central Asia	37.2	38.07
North America	35.66	36.02
World	32.42	31.38
Sub-Saharan Africa	30.65	28.72
East Asia & Pacific	25.57	26.29
South Asia	16.53	17.5
Middle East & North Africa	1.78	2.07

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.08% to 46.14%) and Sub-Sahara Africa (30.65% to 28.72%). 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**

1 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 *527,229.062 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 213.66% from 1990 to 2016.

2 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 (sq.-km)
Brazil	Latin America & Caribbean	541,510.00000
Indonesia	East Asia & Pacific	282,193.98440
Myanmar	East Asia & Pacific	107,234.00390
Nigeria	Sub-Saharan Africa	106,506.00098
Tanzania	Sub-Saharan Africa	102,320.00000

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 the most between 1990 and 2016, we find that four of the top 5 countries on the list are in the region of *Sub-Sahara 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.

3 QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

Quartile	Number of Countries
4	9
1	85
3	38
2	73

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
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

5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
  - ✓ *From 1990 to 2016 the world lost 3.21% of its total land area to deforestation, a total area of **1,324,449 sq.km** and is about the size of Peru.*
  - ✓ Although China and United States are the top two countries that had the most increase in their forest area from 1990 to 2016, further analysis showed that relative to each country's total land area there were 94 countries that had a greater percent increase in forest area to this respect.
  - ✓ The regions responsible for this decrease over the period analyzed were Latin America & Caribbean (dropped from 51.08% to 46.14%) and Sub-Sahara Africa (30.65% to 28.72%).
  - ✓ The countries that had the most contribution to deforestation from these regions were Brazil from Latin America & Caribbean, Nigeria and Tanzania from Sub-Saharan Africa based on absolute forest area change .

- ✓ In percent forest area change Togo, Nigeria, Uganda, and Mauritania from Sub-Saharan Africa, and Honduras from Latin America & Caribbean had the most deforestation

- *Which countries should we focus on over others?*
  In order to reclaim a large proportion of the 1,324,449 sq.km land all over the world lost to deforestation, we should focus on the top 5 countries that had the most decrease in absolute forest area change as detailed in the table below:

	Region	Absolute Forest Area Change (sq.-km)
Brazil	**Latin America & Caribbean**	**541,510.00000**
Indonesia	**East Asia & Pacific**	**282,193.98440**
Myanmar	**East Asia & Pacific**	**107,234.00390**
Nigeria	**Sub-Saharan Africa**	**106,506.00098**
Tanzania	**Sub-Saharan Africa**	**102,320.00000**

APPENDIX

1 GLOBAL SITUATION

```
CREATE VIEW forestation_1
AS
SELECT f.country_code, f.country_name,f.year,
       f.forest_area_sqkm,
       l.total_area_sq_mi,
       ROUND(CAST(f.forest_area_sqkm/(l.total_area_sq_mi * 2.59)*100
AS numeric),2) pct_forest,
       r.region, r.income_group
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
```

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 country_name, forest_area_sqkm
FROM forestation_1
WHERE country_name ='World' and year =1990
```

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 country_name, forest_area_sqkm
FROM forestation_1
WHERE country_name = 'World' AND year = 2016
```

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

```
WITH yr1990 AS(
  SELECT country_name, forest_area_sqkm
  FROM forestation_1
  WHERE country_name ='World' and year =1990),
yr2016 AS (
  SELECT country_name, forest_area_sqkm
  FROM forestation_1
  WHERE country_name = 'World' AND year = 2016)
SELECT a.forest_area_sqkm - b.forest_area_sqkm AS diff_sq_km
FROM yr1990 a
join yr2016 b
ON a.country_name = b.country_name
```

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

```
WITH yr1990 AS(
  SELECT*
  FROM forestation_1
  WHERE country_name ='World' and year =1990),
yr2016 AS (
  SELECT *
  FROM forestation_1
  WHERE country_name = 'World' AND year = 2016)
SELECT (a.forest_area_sqkm -
b.forest_area_sqkm)/a.forest_area_sqkm*100 AS pct_diff_sqkm
FROM yr1990 a
join yr2016 b
ON a.country_code=b.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?

```
SELECT country_name,
       total_area_sq_mi *2.59 AS total_area_sqkm
FROM forestation_1
WHERE year = 2016 AND country_name != 'World' AND
      total_area_sq_mi *2.59 <= (
      SELECT v1.forest_area_sqkm - v2.forest_area_sqkm
world_deforestation
      FROM (SELECT country_name,forest_area_sqkm
            FROM forestation_1
            WHERE country_name ='World' and year =1990) v1
      JOIN (SELECT country_name, forest_area_sqkm
            FROM forestation_1
            WHERE country_name ='World' and year =2016) v2
      ON v1.country_name = v2.country_name)
ORDER BY 2 DESC
LIMIT 1
```

2 REGIONAL OUTLOOK

a. What was the percent forest of the entire world in 2016?

```
SELECT country_name, year, pct_forest
FROM forestation_1
WHERE country_name ='World' and year = 2016
```

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

```
WITH A1 AS(
     SELECT region, year,
ROUND(CAST(SUM(forest_area_sqkm)/SUM(total_area_sq_mi * 2.59)* 100 AS
numeric),2) pct_forest_regions
 FROM forestation_1
 WHERE region != 'World' AND year = 2016
 GROUP BY 1,2)
 SELECT region, pct_forest_regions
 FROM A1
 WHERE pct_forest_regions = ( SELECT MAX(pct_forest_regions)  FROM A1)
 UNION
 SELECT region, pct_forest_regions
 FROM A1
 WHERE pct_forest_regions = ( SELECT MIN(pct_forest_regions)  FROM A1)
```

b. What was the percent forest of the entire world in 1990?

```
SELECT country_name, year, pct_forest
FROM forestation_1
WHERE country_name ='World' and year = 1990
```

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

```
WITH A1 AS(
     SELECT region, year,
            ROUND(CAST(SUM(forest_area_sqkm)/SUM (total_area_sq_mi
*2.59)* 100 AS numeric),2) pct_forest_regions
      FROM forestation_1
      WHERE region != 'World' AND year = 1990
      GROUP BY 1,2)
SELECT region, pct_forest_regions
```

```
 FROM A1
 WHERE pct_forest_regions = ( SELECT MAX(pct_forest_regions)  FROM A1)
 UNION
 SELECT region, pct_forest_regions
 FROM A1
 WHERE pct_forest_regions = ( SELECT MIN(pct_forest_regions)  FROM A1)
WHERE rank in (1,8)
```

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

```
WITH region_2016 AS (
  SELECT region ,
  ROUND(CAST(SUM(forest_area_sqkm) / SUM(total_area_sq_mi *  2.59)*
100 AS numeric),2) AS pct_forest
  FROM forestation_1
  WHERE year = 2016 AND region !='World'
  GROUP BY 1),
region_1990 AS (
  SELECT region ,
  ROUND(CAST(SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)*
100 AS numeric),2) AS pct_forest
  FROM forestation_1
  WHERE year = 1990 AND region !='World'
  GROUP BY 1)
SELECT a.region "Region",
b.pct_forest AS "1990 Forest Percentage",
       a.pct_forest AS "2016 Forest Percentage",
       CASE WHEN b.pct_forest > a.pct_forest THEN 'Decrease'
            ELSE 'Increase' END AS "Change in Region Forest
Percentage"
FROM region_2016 a
JOIN region_1990 b
ON a.region = b.region
```

3 COUNTRY LEVEL-DETAILS

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 forest_1990 AS (
        SELECT country_name,
               region ,
               forest_area_sqkm
        FROM forestation_1
        WHERE year = 1990 AND country_name  != 'World'
        AND forest_area_sqkm IS NOT NULL
            ),
  forest_2016 AS (
        SELECT country_name,
               region ,
               forest_area_sqkm
        FROM forestation_1
        WHERE year = 2016 AND country_name  != 'World'
        AND forest_area_sqkm IS NOT NULL
         )
SELECT a.country_name AS "Country",
         b.region AS "Region",
         a.forest_area_sqkm - b.forest_area_sqkm AS "Absolute Forest
Area Change"
FROM forest_1990 a
JOIN forest_2016 b
ON a.country_name = b.country_name AND a.region = a.region
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 a_90 AS (
    SELECT country_name, region,
    forest_area_sqkm
    FROM forestation_1
    WHERE year= 1990 AND country_name != 'World'
    AND forest_area_sqkm IS NOT NULL
  ),
b_16 AS (
    SELECT country_name, region,
```

```
    forest_area_sqkm
    FROM forestation_1
    WHERE year= 2016 AND country_name != 'World'
    AND forest_area_sqkm IS NOT NULL
  )
SELECT a.country_name AS "Country",
       b.region AS "Region",
       ROUND(CAST((a.forest_area_sqkm-
b.forest_area_sqkm)/a.forest_area_sqkm*100 AS numeric),2) AS "Pct
Forest Area Change"
FROM a_90  a
JOIN b_16 b
ON a.country_name=b.country_name AND a.region = b.region
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?**

```
SELECT CASE WHEN pct_forest > 75 AND pct_forest <=100 THEN 4
   WHEN pct_forest > 50 AND pct_forest <=75 THEN 3
   WHEN pct_forest > 25 AND pct_forest <= 50 THEN 2
   ELSE 1 END AS "Quartile",
COUNT(*) AS "Number of Countries"
FROM forestation_1
WHERE year = 2016 AND pct_forest IS NOT NULL
GROUP BY 1
```

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

```
SELECT country_name AS "Country",
       region AS "Region",
       pct_forest AS "Pct Designated as Forest"
FROM forestation_1
WHERE  year = 2016 AND pct_forest > 75
ORDER BY 3 DESC
```

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

```
SELECT COUNT(*) pct_forest_above_us
FROM forestation_1
WHERE year = 2016 AND pct_forest IS NOT NULL AND
pct_forest > (SELECT pct_forest
              FROM forestation_1
              WHERE year= 2016 AND country_name ='United States')
```