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 sq km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sq km, a loss of 1324449 sq km, or 1.04663259325941%.

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 1279999.99 sq km).

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 & Caribbean, with 98.26%, and the region with the lowest relative forestation was Europe & Central Asia, with 0.00% 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 & Caribbean, with 98.91%, and the region with the lowest relative forestation was Europe & Central Asia, with 0.00% forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	98.91	2.33
Sub-Saharan Africa	88.41	0.21
East Asia & Pacific	91.95	12.50

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 98.9102567906805% to 2.33326844754312%) and Sub-Saharan Africa (88.4111367385789% to 0.214417385139796%). 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 32.4222035575689% to 31.3755709643095%.

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 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 79200 sq km, much lower than the figure for China.

United States 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. China increased in forest area by 5.61593482516787% 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 sq km
Indonesia	East Asia & Pacific	282193.9844 sq km
Myanmar	East Asia & Pacific	107234.0039 sq km
Nigeria	Sub-Saharan Africa	106506.00098 sq km
Tanzania	Sub-Saharan Africa	102320 sq km

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
Honduras	Latin America & Caribbean	32.75%
Korea, Dem. People's Rep.	East Asia & Pacific	27.38%
Zimbabwe	Sub-Saharan Africa	21.75%
Cambodia	East Asia & Pacific	20.48%
Timor-Leste	East Asia & Pacific	19.58%

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 East Asia & Pacific. The countries are Korea, Dem. People's Rep., Cambodia, Timor Leste, and Myanmar. The 5th country on the list is Honduras, which is in the Latin America & Caribbean region.

From the above analysis, we see that Myanmar 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 first 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
Palau	East Asia & Pacific	87.61%
Seychelles	Sub-Saharan Africa	88.41%
Solomon Islands	East Asia & Pacific	77.86%
American Samoa	East Asia & Pacific	87.50%
Guyana	Latin America & Caribbean	83.90%
Suriname	Latin America & Caribbean	98.26%
Lao PDR	East Asia & Pacific	82.11%
Micronesia, Fed. Sts.	East Asia & Pacific	91.86%
Gabon	Sub-Saharan Africa	90.04%

4. RECOMMENDATIONS

According to the World Bank data, the total forest area of the world had fallen 1324449 sq km from 1990 to 2016, which was the most recent year for which data was available. The forest area lost over this time period is slightly more than the entire land area of Peru listed for the year 2016.

The countries we should focus on over the others are Honduras, Korea, Zimbabwe, Cambodia, and Timor Leste as they are the countries included in the top 5 percent decrease in forest area from the year 1990 to 2016.

5. APPENDIX: SQL QUERIES USED

Forestation View:
CREATE VIEW forestation
AS
SELECT f.country_code, f.country_name, f.year, r.region, f.forest_area_sqkm,
l.total_area_sq_mi, r.income_group,
(SUM(f.forest_area_sqkm)/(SUM(l.total_area_sq_mi)*2.59))*100 AS 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
GROUP BY 1, 2, 3, 4, 5, 6, 7

Total forest area (sqkm) of the world in 1990:
SELECT forest_area_sqkm area, region, year
FROM forestation
WHERE year = 1990 AND region = 'World'

Total forest area (sqkm) of the world in 2016:
SELECT forest_area_sqkm area, region, year
FROM forestation
WHERE year = 2016 AND region = 'World'

Change (sqkm) in forest area of the world from 1990 to 2016:
SELECT difference
FROM (SELECT area,
            LEAD(area) OVER (ORDER BY year) AS lead,
            area - LEAD(area) OVER (ORDER BY year) AS difference
      FROM (SELECT forest_area_sqkm area, region, year

```
                    FROM forestation
                    WHERE (year = 1990 OR year = 2016) AND region = 'World') t1) t2
WHERE difference IS NOT NULL
```

Percentage change in forest area of world between 1990 to 2016:
```
SELECT difference
FROM (SELECT area,
                LEAD(area) OVER (ORDER BY year) AS lead,
                area - LEAD(area) OVER (ORDER BY year) AS difference
        FROM (SELECT forest area, region, year
                FROM forestation
                WHERE (year = 1990 OR year = 2016) AND region = 'World') t1) t2
WHERE difference IS NOT NULL
```

The comparison amount of forest area lost between 1990 and 2016, to which country's total area in 2016 is it closest to:
```
SELECT country_name,
    forest_area_sqkm,
    total_area_sq_mi*2.59 total_area_sqkm,
    ABS(total_area_sq_mi*2.59-1324449) AS difference
FROM forestation
WHERE year = 2016
ORDER BY difference
LIMIT 1
```

Percentage of forest of the world in 2016:
```
WITH t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016)

SELECT *
FROM t1
WHERE region = 'World' AND year = 2016
```

Region with highest percentage of forest in 2016:
```
WITH t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016)

SELECT *
FROM t1
```

WHERE year = 2016 AND percent_forest_area IS NOT NULL
ORDER BY percent_forest_area DESC
LIMIT 1

Region with lowest percentage of forest in 2016:
WITH t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016)

SELECT *
FROM t1
WHERE year = 2016 AND percent_forest_area IS NOT NULL
ORDER BY percent_forest_area
LIMIT 1

Percentage of forest of world in 1990:
WITH t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016)

SELECT *
FROM t1
WHERE region = 'World' AND year = 1990

Region with highest percentage of forest in 1990:
WITH t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016)

SELECT *
FROM t1
WHERE year = 1990 AND percent_forest_area IS NOT NULL
ORDER BY percent_forest_area DESC
LIMIT 1

Region with lowest percentage of forest in 1990:
WITH t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016)

```
SELECT *
FROM t1
WHERE year = 2016 AND percent_forest_area IS NOT NULL
ORDER BY percent_forest_area
LIMIT 1
```

Regions decrease in forest area from 1990 to 2016:
```
WITH
t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016),
t1990 AS
(SELECT region, percent_forest_area percent_1990
 FROM t1
 WHERE year = 1990),
t2016 AS
(SELECT region, percent_forest_area percent_2016
 FROM t1
 WHERE year = 2016)

SELECT *
FROM t1990
JOIN t2016
ON t1990.region = t2016.region
WHERE percent_1990 > percent_2016
ORDER BY ABS(percent_1990-percent_2016) DESC, t1990.region
```

Change in forest area in the world:
```
WITH
t1 AS
(SELECT region, forest percent_forest_area, year
 FROM forestation
 WHERE year = 1990 OR year = 2016),
t1990 AS
(SELECT region, percent_forest_area percent_1990
 FROM t1
 WHERE year = 1990),
t2016 AS
(SELECT region, percent_forest_area percent_2016
 FROM t1
 WHERE year = 2016)
```

```
SELECT t1990.percent_1990, t2016.percent_2016
FROM t1990
JOIN t2016
ON t1990.region = t2016.region
WHERE t1990.region = 'World'
```

2 countries with largest increase in forest area from 1990 to 2016:
```
WITH
t1990 AS
(SELECT country_code, country_name, forest_area_sqkm forest_area_sqkm_1990
 FROM forestation
 WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),
t2016 AS
(SELECT country_code, country_name, forest_area_sqkm forest_area_sqkm_2016
 FROM forestation
 WHERE year = 2016 AND forest_area_sqkm IS NOT NULL)

SELECT t1990.country_name, forest_area_sqkm_1990, forest_area_sqkm_2016,
forest_area_sqkm_2016-forest_area_sqkm_1990 difference_sqkm
FROM t1990
JOIN t2016
ON t1990.country_code = t2016.country_code
ORDER BY difference_sqkm DESC
LIMIT 2
```

2 countries with largest land area:
```
SELECT country_name, total_area_sq_mi
FROM forestation
WHERE total_area_sq_mi IS NOT NULL AND country_name != 'World'
ORDER BY total_area_sq_mi DESC
```

China increase in forest area:
```
WITH
t1990 AS
(SELECT country_code, country_name, forest forest_1990
 FROM forestation
 WHERE year = 1990 AND forest IS NOT NULL),
t2016 AS
(SELECT country_code, country_name, forest forest_2016
 FROM forestation
 WHERE year = 2016 AND forest IS NOT NULL)
```

```
SELECT t1990.country_name, forest_1990, forest_2016, forest_2016-forest_1990 difference
FROM t1990
JOIN t2016
ON t1990.country_code = t2016.country_code
WHERE t1990.country_name = 'China'
```

5 countries largest amount decrease in forest area from 1990 to 2016:

```
WITH
t1990 AS
(SELECT country_code, country_name, region,forest_area_sqkm forest_area_sqkm_1990
 FROM forestation
 WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),
t2016 AS
(SELECT country_code, country_name, region, forest_area_sqkm forest_area_sqkm_2016
 FROM forestation
 WHERE year = 2016 AND forest_area_sqkm IS NOT NULL)

SELECT t1990.country_name, t1990.region, forest_area_sqkm_1990, forest_area_sqkm_2016,
forest_area_sqkm_1990-forest_area_sqkm_2016 difference_sqkm
FROM t1990
JOIN t2016
ON t1990.country_code = t2016.country_code
WHERE t1990.country_name != 'World'
ORDER BY difference_sqkm DESC
LIMIT 5
```

5 countries largest percentage decrease in forest area from 1990 to 2016:

```
WITH
t1990 AS
(SELECT country_code, country_name, region, forest forest_1990
 FROM forestation
 WHERE year = 1990 AND forest IS NOT NULL),
t2016 AS
(SELECT country_code, country_name, region, forest forest_2016
 FROM forestation
 WHERE year = 2016 AND forest IS NOT NULL)

SELECT t1990.country_name, t1990.region, forest_1990, forest_2016,
(forest_1990-forest_2016) difference
FROM t1990
JOIN t2016
ON t1990.country_code = t2016.country_code
WHERE t1990.country_name != 'World'
```

```
ORDER BY difference DESC
LIMIT 5
```

Group by percentage forestation in quartiles:
```
SELECT t1.quartile, COUNT(*)
FROM
(SELECT country_code,
        forest,
    CASE
       WHEN forest<25 THEN 1
       WHEN forest>25 AND forest<50 THEN 2
       WHEN forest>50 AND forest<75 THEN 3
       WHEN forest>75 THEN 4
    END AS quartile,
    year
FROM forestation
WHERE year = 2016 AND forest IS NOT NULL) t1
GROUP BY 1
ORDER BY t1.count DESC
```

Countries in 1st quartile:
```
SELECT t1.country_name, t1.region, t1.forest, t1.quartile
FROM
(SELECT country_code,
        forest,
        country_name,
        region,
        CASE
            WHEN forest<25 THEN 1
            WHEN forest>25 AND forest<50 THEN 2
            WHEN forest>50 AND forest<75 THEN 3
            WHEN forest>75 THEN 4
         END AS quartile,
         year
FROM forestation
WHERE year = 2016 AND forest IS NOT NULL) t1
WHERE t1.quartile = 4
GROUP BY 1, 2, 3, 4
ORDER BY t1.count DESC
```