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 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sqkm, a loss of 1324449 sqkm, 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 1279999.9891 sqkm).

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	1990 Forest Percentage	2016 Forest Percentage
East Asia & Pacific	25.78	26.36
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16
Middle East & North Africa	1.78	2.07
North America	35.65	36.04

South Asia	16.51	17.51
Sub-Saharan Africa	30.67	28.79

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Sub-Saharan Africa (dropped from 30.67% to 28.79%) and Latin America & Caribbean (51.03% to 46.16%). 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

•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 527229.06sqkm. 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 79200.00 sqkm, 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.

•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: Brazil, Indonesia and Myanmar.

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	106506.00098
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	59.13
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-Saharan 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.

- QUARTILES

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

Percentage	Quartile	Number of Countries
0 - 25%	1	85
25 - 50%	2	73
50 - 75%	3	38
75 - 100%	4	9

The largest number of countries in 2016 were found in the 1 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 5 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	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

4. RECOMMENDATIONS

Over period of 36 years overall decline of forest area in world make dangerous precedent for world future, as forests are important for biodiversity and also green house effect of the planet. China managed to plant enormous areas of trees, however it can be seen that in recalculation of the area percentage this amount is not as impressive as reforestations which happened in Suriname.
It would be advisable to improve forest areas in the world with such an efficiency as Suriname had.
First world countries should reforest their countries and also help out countries, which economic situation does not enable them to put as much effort in their land.
In general the whole world should concentrate on stopping forest decline and put as much effort in reforestations.

5. APPENDIX
SQL queries used:

```
CREATE VIEW forestation AS
SELECT f.country_code, f.country_name, r.region, r.income_group, f.year,
f.forest_area_sqkm,l.total_area_sq_mi * 2.59 total_area_sqkm,
100*f.forest_area_sqkm/(l.total_area_sq_mi * 2.59) forest_percent
FROM forest_area f
JOIN land_area l
ON f.country_name = l.country_name AND f.year = l.year
JOIN regions r
ON l.country_code = r.country_code
```

GLOBAL SITUATION

```
SELECT forest_area_sqkm
FROM forestation
WHERE year = 1990 AND country_name = 'World';
```

```
SELECT forest_area_sqkm
FROM forestation
WHERE year = 2016 AND country_name = 'World';
```

```
SELECT t1.forest_90 - t2.forest_16 AS loss,
            ROUND(CAST(100 * (t1.forest_90 - t2.forest_16)/ t1.forest_90 AS numeric), 2)
           AS perc_loss
FROM (SELECT country_name, forest_area_sqkm AS forest_90
            FROM forestation
            WHERE year = 1990 AND country_name = 'World') t1
JOIN (SELECT country_name, forest_area_sqkm AS forest_16
          FROM forestation
            WHERE year = 2016 AND country_name = 'World') t2
ON t1.country_name = t2.country_name;
```

```
WITH loss_table as
        (SELECT t1.forest_90 - t2.forest_16 AS loss
         FROM (SELECT country_name, forest_area_sqkm AS forest_90
                     FROM forestation
                     WHERE year = 1990 AND country_name = 'World') t1
           JOIN (SELECT country_name, forest_area_sqkm AS forest_16
                     FROM forestation
```

```
                WHERE year = 2016 AND country_name = 'World') t2
        ON t1.country_name = t2.country_name)
SELECT country_name, total_area_sqkm area
FROM forestation
WHERE total_area_sqkm < (SELECT loss FROM loss_table) AND year = 2016
ORDER BY area DESC
LIMIT 1
```

REGIONAL OUTLOOK

```
SELECT forest_area_sqkm forest, total_area_sqkm land,
        ROUND(CAST(forest_area_sqkm * 100 / total_area_sqkm AS numeric), 2) percentage
FROM forestation
WHERE year = 2016 AND country_name = 'World';
```

```
SELECT region,
        ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
        AS numeric), 2) percentage
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percentage DESC;
```

```
SELECT region,
        ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
        AS numeric), 2) percentage
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY percentage;
```

```
SELECT forest_area_sqkm forest, total_area_sqkm land,
        ROUND(CAST(forest_area_sqkm * 100 / total_area_sqkm AS numeric), 2) percentage
FROM forestation
WHERE year = 1990 AND country_name = 'World';
```

```
SELECT region,
        ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
        AS numeric), 2) percentage
FROM forestation
WHERE year = 1990
```

```
GROUP BY region
ORDER BY percentage DESC;

SELECT region,
        ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
        AS numeric), 2) percentage
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY percentage;

SELECT region,
        ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
        AS numeric), 2) percentage
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY region;

SELECT region,
        ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
        AS numeric), 2) percentage
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY region;


SELECT t1.region, t1.percentage AS perc_90, t2.percentage AS perc_16, t1.percentage -
t2.percentage AS difference
FROM (SELECT region,
                ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
                AS numeric), 2) percentage
        FROM forestation
        WHERE year = 1990
        GROUP BY region
        ORDER BY region) t1
JOIN (SELECT region,
                ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
                AS numeric), 2) percentage
        FROM forestation
        WHERE year = 2016
        GROUP BY region
        ORDER BY region) t2
```

```
ON t1.region = t2.region
WHERE t1.percentage - t2.percentage > 0
ORDER BY difference DESC;

SELECT t1.region, t1.percentage AS perc_90, t2.percentage AS perc_16, t1.percentage -
t2.percentage AS difference
FROM (SELECT region,
                ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
                AS numeric), 2) percentage
        FROM forestation
        WHERE year = 1990
        GROUP BY region
        ORDER BY region) t1
JOIN (SELECT region,
                ROUND(CAST(100*SUM(forest_area_sqkm)/SUM(total_area_sqkm)
                AS numeric), 2) percentage
        FROM forestation
        WHERE year = 2016
        GROUP BY region
        ORDER BY region) t2
ON t1.region = t2.region
WHERE t1.percentage - t2.percentage > 0
ORDER BY difference DESC;
```

COUNTRY-LEVEL DETAIL

```
SELECT t1.country_name,
          ROUND(CAST(t2.forest_16 - t1.forest_90 AS numeric), 2) AS increase
FROM (SELECT country_name, forest_area_sqkm AS forest_90
         FROM forestation
         WHERE year = 1990) t1
JOIN (SELECT country_name, forest_area_sqkm AS forest_16
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name
WHERE COALESCE (t2.forest_16 - t1.forest_90) IS NOT NULL
ORDER BY increase DESC

SELECT t1.country_name,
        ROUND(CAST((t2.forest_16 - t1.forest_90)*100/forest_90 AS numeric), 2) AS
increase_percent
FROM (SELECT country_name, forest_area_sqkm AS forest_90
```

```
 FROM forestation
 WHERE year = 1990) t1
JOIN (SELECT country_name, forest_area_sqkm AS forest_16
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name
WHERE COALESCE (t2.forest_16 - t1.forest_90) IS NOT NULL
ORDER BY increase DESC


SELECT t3.country_name, t3.region, ABS(t3.forest_change)
FROM (SELECT t1.country_name, r.region,
                    ((t2.forest_16 * 100 / t1.land_16) - (t2.forest_90 * 100 / t1.land_90))
                     AS perct_change,
                     t2.forest_16 - t2.forest_90 AS forest_change
          FROM (SELECT l1.country_name,  l1.total_area_sqkm AS land_90,
                              l2.total_area_sqkm AS land_16
                 FROM forestation l1
                 JOIN forestation l2
                 ON l1.country_name = l2.country_name
                 AND l1.year = 1990
                 AND l2.year =2016) t1
          JOIN (SELECT f1.country_name, f1.forest_area_sqkm AS forest_90,
                              f2.forest_area_sqkm AS forest_16
                 FROM forestation f1
                 JOIN forestation f2
                 ON f1.country_name = f2.country_name
                 AND f1.year = 1990
                 AND f2.year = 2016) t2
          ON t1.country_name = t2.country_name
          JOIN regions r
          ON t1.country_name = r.country_name
          WHERE
          COALESCE ((t2.forest_16 * 100 / t1.land_16) - (t2.forest_90 * 100 / t1.land_90))
          IS NOT NULL AND t2.forest_16 - t2.forest_90 < 0
          ORDER BY forest_change) t3
ORDER BY t3.forest_change



SELECT f1.country_name,
             r.region,
             f1.forest_area_sqkm AS forest_90,
             f2.forest_area_sqkm AS forest_16,
```

```
        ROUND(CAST(100 - (f2.forest_area_sqkm * 100 / f1.forest_area_sqkm)
        AS numeric), 2) AS forest_perc_dec
FROM forestation f1
JOIN forestation f2
ON f1.country_name = f2.country_name
AND f1.year = 1990
AND f2.year =2016
JOIN regions r
ON r.country_name = f1.country_name
WHERE COALESCE (f2.forest_area_sqkm * 100 / f1.forest_area_sqkm) IS NOT NULL
ORDER BY forest_perc_dec DESC

SELECT CASE
        WHEN percentage <= 25 THEN '0 - 25%'
        WHEN percentage > 25 AND percentage <= 50 THEN '25 - 50%'
        WHEN percentage > 50 AND percentage <= 75 THEN '50 - 75%'
        WHEN percentage > 75 AND percentage <= 100 THEN '75 - 100%'
        END AS cases,
        COUNT(*)
FROM (SELECT t2.country_name, t2.forest_area, t1.total_area,
                100 * t2.forest_area / t1.total_area percentage
        FROM (SELECT country_name, total_area_sqkm total_area
                FROM forestation
                WHERE year = 2016) t1
        JOIN (SELECT country_name, forest_area_sqkm forest_area
                FROM forest_area
                WHERE year = 2016) t2
        ON t1.country_name = t2.country_name
WHERE COALESCE (100 * t2.forest_area / t1.total_area) IS NOT NULL
ORDER BY percentage DESC) t3
GROUP BY cases
ORDER BY cases

SELECT t2.country_name, t3.region,
        ROUND(CAST(100 * t2.forest_area / t1.total_area AS numeric), 2) percentage
FROM (SELECT country_name, total_area_sqkm total_area
        FROM forestation
        WHERE year = 2016) t1
JOIN (SELECT country_name, forest_area_sqkm forest_area
        FROM forestation
        WHERE year = 2016) t2
ON t1.country_name = t2.country_name
JOIN regions t3
ON t3.country_name = t1.country_name
```

```
WHERE COALESCE (100 * t2.forest_area / t1.total_area) IS NOT NULL
ORDER BY percentage DESC
```