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 3.20824258980244%.

The forest area lost over this time period is slightly more than the entire land area of India listed for the year 2016 (which is 2973190.0079 sq-km).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 31.3755709643095. The region with the highest relative forestation was Latin America & Caribbean, with 46.1620721996047%, and the region with the lowest relative forestation was Middle East & North Africa, with 2.06826486871501% forestation.

In 1990, the percent of the total land area of the world designated as forest was 32.4222035575689. The region with the highest relative forestation was Latin America & Caribbean, with 51.0299798667514%, and the region with the lowest relative forestation was Middle East & North Africa, with 1.77524062469353% forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Middle East & North Africa	1.77524062469353	2.06826486871501
South Asia	16.510767001421	17.5058634081534
East Asia & Pacific	25.7760953973175	26.3586765000485
Sub-Saharan Africa	30.6741454610006	28.7881883550464
World	32.4222035575689	31.3755709643095
North America	35.6511790009015	36.0393609681438
Europe & Central Asia	37.2839398564019	38.0414216032517
Latin America & Caribbean	51.0299798667514	46.1620721996047

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.0299798667514% to 46.1620721996047%) and Sub-Saharan Africa (30.6741454610006% to 28.7881883550464%). 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. Iceland increased in forest area by 68.1188111287129% 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	106506.00098
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	-307.253277422623
Nigeria	Sub-Saharan Africa	-161.779631444907
Uganda	Sub-Saharan Africa	-144.669887738786
Mauritania	Sub-Saharan Africa	-87.7828054298643
Honduras	Latin America & Caribbean	-81.9320214669052

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, 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.

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 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	87.5000875000875
Micronesia, Fed. Sts.	East Asia & Pacific	91.8572390715248
Gabon	Sub-Saharan Africa	90.0376418700565
Guyana	Latin America & Caribbean	83.9014489110682
Lao PDR	East Asia & Pacific	82.1082317640861
Palau	East Asia & Pacific	87.6068085491204
Solomon Islands	East Asia & Pacific	77.8635177945066
Suriname	Latin America & Caribbean	98.2576939676578
Seychelles	Sub-Saharan Africa	88.4111367385789

4. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
  ANSWER –
  The percentage forestation in the world has decreased from 32.42% to 31.37% between the years 1990 and 2016. Except of two regions, the percentage forestation has actually increased in all the regions but the fall in percentage forest area was so large in those two regions that it eventually led to the decrement of the percentage forest coverage of the world.
- *Which countries should we focus on over others?*
  ANSWER –
  Countries which have very less percentage of forest coverage and the countries which are getting their forest area decreased are the ones we should focus on over the others. The countries which have got their percentage forest area decreased between 1990 and 2016 are also the ones we should focus on over the others.

5. APPENDIX: SQL Queries Used

1. forestation view

```sql
CREATE VIEW forestation AS
        SELECT
            f.country_code,
            f.country_name,
            r.region,
            f.year,
            f.forest_area_sqkm,
            l.total_area_sq_mi,
            r.income_group,
         ((f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) * 100) AS forest_percent
        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
```

2. total forest area in the world in 1990

```sql
SELECT country_code,
        year,
        forest_area_sqkm
FROM forest_area
WHERE country_code = 'WLD' AND year = 1990
```

3. total forest area in the world in 2016

```
SELECT country_code,
        year,
        forest_area_sqkm
FROM forest_area
WHERE country_code = 'WLD' AND year = 2016
```

4. change (in sq km) in the forest area of the world from 1990 to 2016

```
WITH T1 AS (
        SELECT country_code,
               year,
               forest_area_sqkm
        FROM forest_area
        WHERE country_code = 'WLD' AND (year IN (1990,2016))
)
SELECT forest_area_sqkm - LAG (forest_area_sqkm) OVER (ORDER BY forest_area_sqkm)
AS loss_forest_area_sqkm
FROM T1
ORDER BY 1
LIMIT 1
```

5. percent change in forest area of the world between 1990 and 2016

```
WITH T1 AS (
        SELECT country_code,
               year,
               forest_area_sqkm
        FROM forest_area
        WHERE country_code = 'WLD' AND (year IN (1990,2016))
)
SELECT ((forest_area_sqkm - LAG (forest_area_sqkm) OVER (ORDER BY forest_area_sqkm))
/ forest_area_sqkm) * 100 AS percentage_loss_forest_area_sqkm
FROM T1
ORDER BY 1
LIMIT 1
```

6. country with total area slightly less than that of the forest area lost between 1990 and 2016

```
WITH T1 AS (
        SELECT country_code,
               year,
               forest_area_sqkm
        FROM forest_area
        WHERE country_code = 'WLD' AND (year IN (1990,2016))
)
SELECT country_name,
        total_area_sq_mi * 2.59 AS land_area_sqkm
FROM land_area
WHERE total_area_sq_mi <= (
        SELECT (forest_area_sqkm - LAG (forest_area_sqkm) OVER (ORDER BY
forest_area_sqkm)) AS change_forest_area_sqkm
        FROM T1
        ORDER BY 1
        LIMIT 1
) AND year = 2016
ORDER BY 2 DESC
LIMIT 1
```

7. percent forest area of the world in 1990 and 2016

```
WITH T1 AS (
        SELECT r.region,
               f.year,
               (SUM (f.forest_area_sqkm) / (SUM (l.total_area_sq_mi * 2.59)) * 100)
AS percent_forest_area
        FROM land_area l
        JOIN forest_area f
        ON l.country_code = f.country_code AND l.year = f.year
        JOIN regions r
        ON f.country_code = r.country_code
        GROUP BY 1,2
        HAVING f.year = 1990 OR f.year = 2016
)
SELECT *
FROM T1
WHERE region = 'World'
```

8. table showing the regions and their percent forest area in both 1990 and 2016

```
WITH T1 AS (
        SELECT r.region,
               f.year,
        (SUM (f.forest_area_sqkm) / (SUM (l.total_area_sq_mi * 2.59)) * 100) AS
percent_forest_area
        FROM land_area l JOIN forest_area f
        ON l.country_code = f.country_code AND l.year = f.year
        JOIN regions r
        ON f.country_code = r.country_code
        GROUP BY 1,2
        HAVING f.year = 1990 OR f.year = 2016
)
SELECT *
FROM T1
```

9. region with highest percent forest area in 2016

```
WITH T1 AS (
        SELECT r.region,
               f.year,
        (SUM (f.forest_area_sqkm) / (SUM (l.total_area_sq_mi * 2.59)) * 100) AS
percent_forest_area
        FROM land_area l JOIN forest_area f
        ON l.country_code = f.country_code AND l.year = f.year
        JOIN regions r
        ON f.country_code = r.country_code
        GROUP BY 1,2
        HAVING f.year = 1990 OR f.year = 2016
)
SELECT *
FROM T1
WHERE year = 2016
ORDER BY percent_forest_area DESC
LIMIT 1;
```

10. region with highest percent forest area in 1990

```
WITH T1 AS (
        SELECT r.region,
               f.year,
        (SUM (f.forest_area_sqkm) / (SUM (l.total_area_sq_mi * 2.59)) * 100) AS
percent_forest_area
        FROM land_area l
        JOIN forest_area f
        ON l.country_code = f.country_code AND l.year = f.year
        JOIN regions r
        ON f.country_code = r.country_code
        GROUP BY 1,2
        HAVING f.year = 1990 OR f.year = 2016
)
SELECT *
FROM T1
WHERE year = 1990
ORDER BY percent_forest_area DESC
LIMIT 1;
```

11. region with lowest percent forest area in 2016

```
WITH T1 AS (
        SELECT r.region,
               f.year,
        (SUM (f.forest_area_sqkm) / (SUM (l.total_area_sq_mi * 2.59)) * 100) AS
percent_forest_area
        FROM land_area l
        JOIN forest_area f
        ON l.country_code = f.country_code AND l.year = f.year
        JOIN regions r
        ON f.country_code = r.country_code
        GROUP BY 1,2
        HAVING f.year = 1990 OR f.year = 2016
)
SELECT *
FROM T1
WHERE year = 2016
ORDER BY percent_forest_area
LIMIT 1;
```

12. region with lowest percent forest area in 1990

```
WITH T1 AS (
        SELECT r.region,
               f.year,
        (SUM (f.forest_area_sqkm) / (SUM (l.total_area_sq_mi * 2.59)) * 100) AS
percent_forest_area
        FROM land_area l
        JOIN forest_area f ON l.country_code = f.country_code AND l.year = f.year
        JOIN regions r
        ON f.country_code = r.country_code
        GROUP BY 1,2
        HAVING f.year = 1990 OR f.year = 2016
)
SELECT *
FROM T1
WHERE year = 1990
ORDER BY percent_forest_area
LIMIT 1;
```

13. 5 countries which saw the largest amount decrease in forest area from 1990 to 2016

```
WITH T1 AS (
        SELECT f.country_name,
               f.year,
               f.forest_area_sqkm,
               r.region,
        LAG (forest_area_sqkm) OVER (PARTITION BY f.country_code ORDER BY year)
        FROM forest_area f
        JOIN regions r
        ON f.country_code = r.country_code
        WHERE year = 1990 OR year = 2016
)
SELECT country_name,
        region,
        forest_area_sqkm - lag AS change_forest_area,
        ((forest_area_sqkm - lag) / forest_area_sqkm) * 100 AS
percentage_change_forest_area
FROM T1
WHERE (forest_area_sqkm - lag) IS NOT NULL
ORDER BY 3
LIMIT 5
```

14. 5 countries which saw the largest percent decrease in forest area from 1990 to 2016

```
WITH T1 AS (
        SELECT f.country_name,
               f.year,
               f.forest_area_sqkm,
               r.region,
        LAG (forest_area_sqkm) OVER (PARTITION BY f.country_code ORDER BY year)
        FROM forest_area f
        JOIN regions r
        ON f.country_code = r.country_code
        WHERE year = 1990 OR year = 2016
)
SELECT country_name,
        region,
        forest_area_sqkm - lag AS change_forest_area,
        ((forest_area_sqkm - lag) / forest_area_sqkm) * 100 AS
percentage_change_forest_area
FROM T1
WHERE forest_area_sqkm - lag IS NOT NULL
ORDER BY 4
LIMIT 5
```

15. number of countries in each quartile when grouped by percentage forest in 2016 in each country

```
WITH T1 AS (
        SELECT f.country_name,
               f.year,
               r.region,
        (f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) * 100 AS forest_percent
        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
        WHERE f.year = 2016
)
SELECT CASE WHEN forest_percent < 25
            THEN 'quartille_1'
             WHEN forest_percent >= 25 AND forest_percent < 50
            THEN 'quartile_2' WHEN forest_percent >= 50 AND forest_percent < 75
            THEN 'quartile_3'
            ELSE 'quartile_4'
            END AS quartiles,
             COUNT (forest_percent)
FROM T1
GROUP BY 1
ORDER BY 1
```

16. List of all the countries that were in the 4th quartile (percent forest > 75%) in 2016

```
WITH T1 AS (
        SELECT f.country_name,
               f.year,
               r.region,
        (f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) * 100 AS forest_percent
        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
        WHERE f.year = 2016
)
SELECT country_name,
        region,
        forest_percent
FROM T1
WHERE forest_percent > 75
```

17. number of countries that had a percent forestation higher than the United States in 2016

```
WITH T1 AS (
        SELECT f.country_name,
               f.year,
               r.region,
        (f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) * 100 AS forest_percent
        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
        WHERE f.year = 2016
)
SELECT COUNT (forest_percent)
FROM T1
WHERE forest_percent > (
        SELECT forest_percent
        FROM T1
        WHERE country_name = 'United States'
)
```