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 **41,282,694.90 SQ KM** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.90 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 **1,279,999.99** 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 **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 & 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%
Europe & Central Asia	37.28%	38.04%
North America	35.65%	36.04%
Sub-Saharan Africa	30.67%	28.79%
East Asia & Pacific	25.78%	26.36%
South Asia	16.51%	17.51%
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 **51.03%** 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 in forest area from 1990 to 2016 by **527,229.06 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.

The 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's** forest area increased by **213.66%** 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: **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	-541,510.00 SQ KM
Indonesia	East Asia & Pacific	-282,193.98 SQ KM
Myanmar	East Asia & Pacific	-107,234.00 SQ KM
Nigeria	Sub-Saharan Africa	-106,506.00 SQ KM
Tanzania	Sub-Saharan Africa	-102,320.00 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
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 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
0-25%	85
25% - 50%	72
50% - 75%	38
75% - 100%	9

The largest number of countries in 2016 were found in the first quartile.

There were nine countries in the fourth 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
Solomon Islands	East Asia & Pacific	77.86%
Lao PDR	East Asia & Pacific	82.11%
Guyana	Latin America & Caribbean	83.90%
American Samoa	East Asia & Pacific	87.50%
Palau	East Asia & Pacific	87.61%

Seychelles	Sub-Saharan Africa	88.41%
Gabon	Sub-Saharan Africa	90.04%
Micronesia, Fed. Sts	East Asia & Pacific	91.86%
Suriname	Latin America & Caribbean	98.26%

5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*

In the last 26 years the overall forestation in the world has decreased significantly. If we allow these trends to continue there could be little forestation left in the future. However, it is encouraging that only the two regions of Latin America & Caribbean and Sub-Saharan Africa have decreased while the other five world regions have increased in their forested area. It seems that the country of Brazil is the biggest concern as they have lost an area of forest much higher than any other country. It is encouraging however that countries like China and the USA have seen a large increase in their forested areas.

- *Which countries should we focus on over others?*

We have to focus on decreasing the destruction of forests in countries like Brazil and Indonesia. Those countries have the biggest issue with deforestation and if something is not done those trends could continue or even increase in the upcoming decades. However, we must also focus just as much on encouraging countries like China and the USA, who have been increasing their forests over the last few decades to continue and increase this trend. It will be a lot easier to get countries to increase their forestation than having countries decrease their deforestation. With this two pronged approach it seems logical that in the next couple of decades the World percentage of deforestation can be decreased and then the trend can be reversed so that the forestation in the world is increasing every decade.

6. Appendix: SQL queries used

Create a **View** called **“forestation”**

```
DROP VIEW IF EXISTS forestation;
```

```
CREATE VIEW forestation
AS
  (SELECT f.country_code,
          f.country_name,
          f.year,
          f.forest_area_sqkm,
          l.total_area_sq_mi,
          r.region,
          r.income_group,
          Round(( l.total_area_sq_mi * 2.59 ) :: numeric, 2) AS
land_area_sqkm,
          Round(( ( f.forest_area_sqkm / ( l.total_area_sq_mi * 2.59
) ) * 100 )
                ::
                numeric, 2)                                    AS
             percent_land_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 f.country_code = r.country_code
   ORDER  BY f.country_name,
             f.year);
```

1. GLOBAL SITUATION

Forest area of the world

```
WITH forestation_1990
     AS (SELECT country_name,
                year,
                forest_area_sqkm
         FROM   forestation
         WHERE  year = 1990),
     forestation_2016
     AS (SELECT country_name,
                year,
                forest_area_sqkm
         FROM   forestation
         WHERE  year = 2016),
```

```
     joined_forestation_1990_2016
     AS (SELECT w90.country_name,
                w90.year,
                w90.forest_area_sqkm AS forest_area_sqkm_1990,
                w16.forest_area_sqkm AS forest_area_sqkm_2016
         FROM   forestation_1990 w90
                join forestation_2016 w16
                  ON w90.country_name = w16.country_name)
SELECT *,
       ( forest_area_sqkm_1990 - forest_area_sqkm_2016 )    AS diff,
       Round(( ( forest_area_sqkm_1990 - forest_area_sqkm_2016 ) *
100 /
                     forest_area_sqkm_1990 ) :: NUMERIC, 2) AS
percentage_diff
FROM   joined_forestation_1990_2016
WHERE  country_name LIKE 'World'
```

Which country's total area in 2016 is it closest to?

```
SELECT country_name,
       year,
       land_area_sqkm
FROM   forestation
WHERE  year = 2016
ORDER  BY land_area_sqkm DESC
```

2. REGIONAL OUTLOOK

Regions and their percent forest area

```
WITH forest_percentage_1990
     AS (SELECT region,
                Round(( ( SUM(forest_area_sqkm) / SUM(land_area_sqkm)
) * 100 )
                      ::
                     NUMERIC, 2)
                AS regional_percent_forest_area_1990
         FROM   forestation
         WHERE  year = 1990
         GROUP  BY 1),
     forest_percentage_2016
```

```
     AS (SELECT region,
                Round(( ( SUM(forest_area_sqkm) / SUM(land_area_sqkm)
) * 100 )
                      ::
                      NUMERIC, 2)
                AS regional_percent_forest_area_2016
         FROM   forestation
         WHERE  year = 2016
         GROUP  BY 1),
     joined_1990_2016
     AS (SELECT f90.region,
                f16.region,
                f90.regional_percent_forest_area_1990,
                f16.regional_percent_forest_area_2016
         FROM   forest_percentage_1990 f90
                join forest_percentage_2016 f16
                  ON f90.region = f16.region)
SELECT *
FROM   joined_1990_2016
ORDER  BY regional_percent_forest_area_2016 DESC
```

3. COUNTRY-LEVEL DETAIL

Success Stories - Increase in forest area KM

```
WITH forestation_1990
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
         FROM   forestation
         WHERE  year = 1990),
     forestation_2016
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
         FROM   forestation
```

```
        WHERE  year = 2016),
     joined_1990_2016
     AS (SELECT f90.country_name,
                f90.region,
                f90.forest_area_sqkm AS forest_area_1990,
                f16.forest_area_sqkm AS forest_area_2016,
                f90.land_area_sqkm   AS land_area_1990,
                f16.land_area_sqkm   AS land_area_2016
         FROM   forestation_1990 f90
                join forestation_2016 f16
                  ON f90.country_name = f16.country_name
                     AND f90.region = f16.region)
SELECT country_name,
       region,
       Round(( forest_area_2016 - forest_area_1990 ) :: NUMERIC, 2)
AS
       diff_forest_area,
       Round(( ( forest_area_2016 - forest_area_1990 ) /
forest_area_1990 * 100
             ) ::
             NUMERIC, 2)
AS
       percent_diff_forest_area
FROM   joined_1990_2016
WHERE  forest_area_1990 IS NOT NULL
       AND forest_area_2016 IS NOT NULL
ORDER  BY diff_forest_area DESC
```

Success Stories - Largest percent change

```
WITH forestation_1990
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
         FROM   forestation
         WHERE  year = 1990),
     forestation_2016
     AS (SELECT country_name,
                region,
```

```
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
         FROM   forestation
         WHERE  year = 2016),
     joined_1990_2016
     AS (SELECT f90.country_name,
                f90.region,
                f90.forest_area_sqkm AS forest_area_1990,
                f16.forest_area_sqkm AS forest_area_2016,
                f90.land_area_sqkm   AS land_area_1990,
                f16.land_area_sqkm   AS land_area_2016
         FROM   forestation_1990 f90
                join forestation_2016 f16
                  ON f90.country_name = f16.country_name
                     AND f90.region = f16.region)
SELECT country_name,
       region,
       Round(( forest_area_2016 - forest_area_1990 ) :: NUMERIC, 2)
AS
       diff_forest_area,
       Round(( ( forest_area_2016 - forest_area_1990 ) /
forest_area_1990 * 100
             ) ::
             NUMERIC, 2)
AS
       percent_diff_forest_area
FROM   joined_1990_2016
WHERE  forest_area_1990 IS NOT NULL
       AND forest_area_2016 IS NOT NULL
ORDER  BY percent_diff_forest_area DESC
```

Largest amount decrease in forest area

```
WITH forestation_1990
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
         FROM   forestation
         WHERE  year = 1990),
```

```
     forestation_2016
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
         FROM   forestation
         WHERE  year = 2016),
     joined_1990_2016
     AS (SELECT f90.country_name,
                f90.region,
                f90.forest_area_sqkm AS forest_area_1990,
                f16.forest_area_sqkm AS forest_area_2016,
                f90.land_area_sqkm   AS land_area_1990,
                f16.land_area_sqkm   AS land_area_2016
         FROM   forestation_1990 f90
                join forestation_2016 f16
                  ON f90.country_name = f16.country_name
                     AND f90.region = f16.region)
SELECT country_name,
       region,
       Round(( forest_area_2016 - forest_area_1990 ) :: NUMERIC, 2)
AS
       diff_forest_area,
       Round(( ( forest_area_2016 - forest_area_1990 ) /
forest_area_1990 * 100
             ) ::
             NUMERIC, 2)
AS
       percent_diff_forest_area
FROM   joined_1990_2016
WHERE  country_name NOT LIKE 'World'
ORDER  BY diff_forest_area
```

Largest percent decrease in forest area

```
WITH forestation_1990
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
```

```
        FROM   forestation
        WHERE  year = 1990),
     forestation_2016
     AS (SELECT country_name,
                region,
                year,
                forest_area_sqkm,
                land_area_sqkm,
                percent_land_as_forest
        FROM   forestation
        WHERE  year = 2016),
     joined_1990_2016
     AS (SELECT f90.country_name,
                f90.region,
                f90.forest_area_sqkm AS forest_area_1990,
                f16.forest_area_sqkm AS forest_area_2016,
                f90.land_area_sqkm   AS land_area_1990,
                f16.land_area_sqkm   AS land_area_2016
        FROM   forestation_1990 f90
                join forestation_2016 f16
                  ON f90.country_name = f16.country_name
                     AND f90.region = f16.region)
SELECT country_name,
       region,
       Round(( forest_area_2016 - forest_area_1990 ) :: NUMERIC, 2)
AS
       diff_forest_area,
       Round(( ( forest_area_2016 - forest_area_1990 ) /
forest_area_1990 * 100
             ) ::
             NUMERIC, 2)
AS
       percent_diff_forest_area
FROM   joined_1990_2016
WHERE  country_name NOT LIKE 'World'
ORDER  BY percent_diff_forest_area
```

Quartiles

```
WITH t1
     AS (SELECT year,
                percent_land_as_forest,
                CASE
                  WHEN percent_land_as_forest < 25 THEN '0-25%'
```

```
                  WHEN percent_land_as_forest > 75 THEN '75% - 100%'
                  WHEN percent_land_as_forest BETWEEN 25 AND 50 THEN
'25% - 50%'
                  ELSE '50% - 75%'
                END AS quartiles
          FROM   forestation
          WHERE  year = 2016
                 AND country_name != 'World'
                 AND percent_land_as_forest IS NOT NULL)
SELECT quartiles,
       Count(CASE
               WHEN percent_land_as_forest < 25 THEN '0-25%'
               WHEN percent_land_as_forest > 75 THEN '75% - 100%'
               WHEN percent_land_as_forest BETWEEN 25 AND 50 THEN
'25% - 50%'
               ELSE '50% - 75%'
             END) AS number_of_countries
FROM   t1
WHERE  year = 2016
GROUP  BY quartiles
```

Countries that were in the 4th quartile

```
SELECT country_name,
       region,
       CASE
         WHEN percent_land_as_forest < 25 THEN '0-25%'
         WHEN percent_land_as_forest > 75 THEN '75% - 100%'
         WHEN percent_land_as_forest BETWEEN 25 AND 50 THEN '25% -
50%'
         ELSE '50% - 75%'
       END AS quartiles
FROM   forestation
WHERE  year = 2016
ORDER  BY quartiles DESC,
          percent_land_as_forest
```