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 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 41282694.90 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.90 sqkm, a loss of 1324449.00 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 1279999.99 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 98.26%, 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%
World	32.42%	31.38%

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 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 increased in forest area from 1990 to 2016 by 527229.06 sqkm. 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 the 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 212.50% 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: 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	541510.00 sqkm
Indonesia	East Asia & Pacific	282193.98 sqkm
Myanmar	East Asia & Pacific	107234.00 sqkm
Nigeria	Sub-Saharan Africa	106506.00 sqkm
Tanzania	Sub-Saharan Africa	102320.00 sqkm

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	75.46%
Nigeria	Sub-Saharan Africa	61.79%
Uganda	Sub-Saharan Africa	59.59%
Mauritania	Sub-Saharan Africa	47.50%
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.

3. 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 0 – 25% 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	87.50%
Guyana	Latin America & Caribbean	83.90%
Lao	PDR	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?*
- *Which countries should we focus on over others?*

Nigeria is a strong candidate country that deserves ForestQuery's attention. It was the only country to make the top five in both forest percentage loss and forest area loss. Here are my following recommendations of actions to take in Nigeria to help combat the deforestation rate:

Reforestation is a measure that could be taken as the National Environmental Standards and Regulations Agency (NESREA) in Nigeria has already been empowered by law to tackle this method of planting trees to replace ones lost. In 2005 alone, approximately 1 million hectares of land have been reforested.

Lobbying for the protection of the existing forest. Enforcing logging regulations and implementing a mandatory "plant a tree" program for all logging companies could assist in the efforts of reforestation. We can also help to lobby for forest guards to be equipped with the necessary tools and equipment to help ensure effective and efficient job completions.

Lastly, we can help educate citizens on the small things they can do to help impact the reforestation effort. Going paperless, eating less meat, and focusing efforts on finding alternative forms of cooking fuel, like kerosene, could help reduce the need for logging and forest clearing.

Appendix

Creating the View

```
DROP VIEW IF EXISTS forestation; CREATE VIEW forestation AS
            (
                  SELECT f.country_code,
                        f.country_name,
                        f.year,
                        Round(f.forest_area_sqkm::numeric, 2) AS forest_area_sqkm,
                        Round((l.total_area_sq_mi * 2.59)::numeric,2)  AS total_land_area_sqkm,
                        Round((f.forest_area_sqkm / (l.total_area_sq_mi * 2.59) * 100)::numeric
,2)  AS percentage_of_forest,
                        r.region,
                        r.income_group
                  FROM   forest_area AS f
                  JOIN   land_area   AS l
                  ON     f.year = l.year
                  AND    f.country_code = l.country_code
                  JOIN   regions AS r
                  ON     r.country_code = l.country_code
            );SELECT *
FROM   forestation
LIMIT 300;
```

Global Situation Q 1A

```
SELECT year,
       Sum(forest_area_sqkm) AS total_forest_area_sqkm
FROM   forestation
WHERE  region = 'World'
       AND year = 1990
GROUP  BY 1;
```

Global Situation Q 1B

```
SELECT year,
       Sum(forest_area_sqkm) AS total_forest_area_sqkm
FROM   forestation
WHERE  region = 'World'
       AND year = 2016
GROUP  BY 1;
```

Global Situation Q 1C

```
WITH forest_area_2016
     AS (SELECT year,
                Sum(forest_area_sqkm) AS total_forest_area_2016
         FROM   forestation
         WHERE  region = 'World'
                AND year = 2016
         GROUP  BY 1),
     forest_area_1990
     AS (SELECT year,
                Sum(forest_area_sqkm) AS total_forest_area_1990
         FROM   forestation
         WHERE  region = 'World'
                AND year = 1990
         GROUP  BY 1)
SELECT total_forest_area_1990 - total_forest_area_2016 AS difference
FROM   forest_area_2016,
       forest_area_1990
```

Global Situation Q 1D

```
WITH forest_area_2016
     AS (SELECT year,
                Sum(forest_area_sqkm) AS total_forest_area_2016
         FROM   forestation
         WHERE  region = 'World'
                AND year = 2016
         GROUP  BY 1),
     forest_area_1990
     AS (SELECT year,
                Sum(forest_area_sqkm) AS total_forest_area_1990
         FROM   forestation
         WHERE  region = 'World'
                AND year = 1990
         GROUP  BY 1)
SELECT ( total_forest_area_1990 - total_forest_area_2016 ) * 100 /
       total_forest_area_1990 AS diff_percentage
FROM   forest_area_2016,
       forest_area_1990
```

Global Situation Q 1E

```
WITH forest_area_2016 AS
(
         SELECT   year,
                  Sum(forest_area_sqkm) AS total_forest_area_2016
         FROM     forestation
         WHERE    region = 'World'
         AND      year = 2016
         GROUP BY 1),
       forest_area_1990 AS
(
         SELECT   year,
                  Sum(forest_area_sqkm) AS total_forest_area_1990
         FROM     forestation
         WHERE    region = 'World'
         AND      year = 1990
         GROUP BY 1),
       difference_forest_area AS
(
       SELECT (total_forest_area_1990 - total_forest_area_2016) AS difference
       FROM   forest_area_2016,
              forest_area_1990)
SELECT   country_name,
         total_land_area_sqkm
FROM     forestation
WHERE    year = 2016
AND      total_land_area_sqkm < 1324449
ORDER BY 2 DESC limit 2;
```

Regional Outlook Q 1A

```
WITH percentage_forest_2016
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) / SUM(total_land_area_sqkm) * 100
                      ) ::
                      NUMERIC, 2)
                AS percentage_2016
         FROM   forestation
         WHERE  year = 2016
         GROUP  BY 1),
     percentage_forest_1990
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) / SUM(total_land_area_sqkm) * 100
                      ) ::
                      NUMERIC, 2)
                AS percentage_1990
         FROM   forestation
         WHERE  year = 1990
         GROUP  BY 1),
     joined_2016_1990
     AS (SELECT percentage_forest_2016.region,
                percentage_1990,
                percentage_2016
         FROM   percentage_forest_2016
                join percentage_forest_1990
                  ON percentage_forest_2016.region =
                     percentage_forest_1990.region)
SELECT region,
       Min(percentage_2016)
FROM   joined_2016_1990
GROUP  BY 1
ORDER  BY 2 ASC

/////
SELECT region,
       Max(percentage_2016)
FROM   joined_2016_1990
GROUP  BY 1
ORDER  BY 2 DESC

/////

SELECT region,
       Sum(percentage_2016)
FROM   joined_2016_1990
WHERE   region = 'World'
GROUP  BY 1
ORDER  BY 2 SUM
```

Regional Outlook Q 1B

```
WITH percentage_forest_2016
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) / SUM(total_land_area_sqkm) * 100
                      ) ::
                      NUMERIC, 2)
                AS percentage_2016
         FROM   forestation
         WHERE  year = 2016
         GROUP  BY 1),
     percentage_forest_1990
     AS (SELECT region,
                Round(( SUM(forest_area_sqkm) / SUM(total_land_area_sqkm) * 100
                      ) ::
                      NUMERIC, 2)
                AS percentage_1990
         FROM   forestation
         WHERE  year = 1990
         GROUP  BY 1),
     joined_2016_1990
     AS (SELECT percentage_forest_2016.region,
                percentage_1990,
                percentage_2016
         FROM   percentage_forest_2016
                join percentage_forest_1990
                  ON percentage_forest_2016.region =
                     percentage_forest_1990.region)
SELECT region,
       Min(percentage_1990)
FROM   joined_2016_1990
GROUP  BY 1
ORDER  BY 2 ASC

/////
SELECT region,
       Max(percentage_1990)
FROM   joined_2016_1990
GROUP  BY 1
ORDER  BY 2 DESC

/////

SELECT region,
       Sum(percentage_1990)
FROM   joined_2016_1990
GROUP  BY 1
ORDER  BY 2 SUM
```

Regional Outlook Q 1C

```
WITH world_forest_2016 AS
(
         SELECT   region,
                  Sum(percentage_of_forest) AS sum_forest_2016
         FROM     forestation
         WHERE    year = 2016
         GROUP BY 1
         ORDER BY 2 DESC ), world_forest_1990 AS
(
         SELECT   region,
                  Sum(percentage_of_forest) AS sum_forest_1990
         FROM     forestation
         WHERE    year = 1990
         GROUP BY 1
         ORDER BY 2 DESC )
SELECT   forestation.region,
         sum_forest_2016,
         sum_forest_1990,
         (sum_forest_1990 - sum_forest_2016) AS forest_difference
FROM     world_forest_1990,
         world_forest_2016,
         forestation
GROUP BY 1,
         2,
         3
ORDER BY 4 ASC limit 10;
```

Country-Level Detail Fill-In-the-Blank Answers

```
WITH country_forest_2016 AS
(
       SELECT country_name,
              region,
              forest_area_sqkm AS forest_2016
       FROM   forestation
       WHERE  year = 2016 ), country_forest_1990 AS
(
       SELECT country_name,
              region,
              forest_area_sqkm AS forest_1990
       FROM   forestation
       WHERE  year = 1990 ), joined_2016_1990 AS
(
       SELECT country_forest_2016.country_name,
              country_forest_2016.region,
              country_forest_2016.forest_2016,
              country_forest_1990.forest_1990
       FROM   country_forest_2016
       JOIN   country_forest_1990
       ON     country_forest_2016.country_name = country_forest_1990.country_name )
SELECT   country_name,
         region,
         (forest_2016 - forest_1990) AS forest_difference
FROM     joined_2016_1990
WHERE    forest_2016 > forest_1990
ORDER BY 3 DESC limit 2
```

Country-Level Detail Q 1A

```
WITH country_forest_2016 AS
(
       SELECT country_name,
              region,
              forest_area_sqkm AS forest_2016
       FROM   forestation
       WHERE  year = 2016 ), country_forest_1990 AS
(
       SELECT country_name,
              region,
              forest_area_sqkm AS forest_1990
       FROM   forestation
       WHERE  year = 1990 ), joined_2016_1990 AS
(
       SELECT country_forest_2016.country_name,
              country_forest_2016.region,
              country_forest_2016.forest_2016,
              country_forest_1990.forest_1990
       FROM   country_forest_2016
       JOIN   country_forest_1990
       ON     country_forest_2016.country_name = country_forest_1990.country_name )
SELECT   country_name,
         region,
         Abs(forest_1990 - forest_2016) AS forest_difference
FROM     joined_2016_1990
WHERE    forest_2016 < forest_1990
AND      region != 'World'
ORDER BY 3 DESC limit 5
```

Country-Level Detail Q 1B

```
WITH country_forest_2016 AS
(
       SELECT country_name,
              percentage_of_forest AS percentage_forest_2016
       FROM   forestation
       WHERE  year = 2016 ), country_forest_1990 AS
(
       SELECT country_name,
              percentage_of_forest AS percentage_forest_1990
       FROM   forestation
       WHERE  year = 1990 ), joined_2016_1990 AS
(
       SELECT country_forest_2016.country_name,
              country_forest_2016.percentage_forest_2016,
              country_forest_1990.percentage_forest_1990
       FROM   country_forest_2016
       JOIN   country_forest_1990
       ON     country_forest_2016.country_name = country_forest_1990.country_name )
SELECT   country_name,
         Round(((percentage_forest_2016 - percentage_forest_1990) / percentage_forest_1990 * 100)
::numeric,2) AS percent_difference
FROM     joined_2016_1990
WHERE    percentage_forest_2016 > percentage_forest_1990
ORDER BY 2 DESC limit 1
```

Country-Level Detail Q 1C

```
SELECT CASE
         WHEN percentage_of_forest <= 25 THEN '0 - 25%'
         WHEN percentage_of_forest > 25
              AND percentage_of_forest <= 50 THEN '25 - 50%'
         WHEN percentage_of_forest > 50
              AND percentage_of_forest <= 75 THEN '50 - 75%'
         WHEN percentage_of_forest > 75
              AND percentage_of_forest <= 100 THEN '75 - 100%'
         ELSE 'null'
       END AS quartiles,
       country_name,
       region,
       percentage_of_forest
FROM   forestation
WHERE  year = 2016
       AND country_name != 'World'
       AND percentage_of_forest > 75
       AND percentage_of_forest <= 100
GROUP  BY 1,
          2,
          3,
          4
ORDER  BY 4 DESC
```