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 41,282,694.9 sq km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9, 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 in the year 2016 (which is 1,279,999.99 sq km).

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 East Asia & Pacific, with 50.09%, and the region with the lowest relative forestation was Middle East & North Africa, with 3.19% 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 East Asia & Pacific, with 47.38%, and the region with the lowest relative forestation was Middle East & North Africa, with 2.69% forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
East Asia & Pacific	47.38	50.09
Latin America & Caribbean	43.34	41.64
World	32.42	31.38
Sub-Saharan Africa	35.26	31.28
North America	29.95	30.20
Europe & Central Asia	26.33	28.31
South Asia	20.68	21.60
Middle East & North Africa	2.69	3.19

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 43.34% to 41.64%) and Sub-Saharan Africa (35.26% to 31.28%). 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.

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 2.13% 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 5 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 (in sq km)
Brazil	Latin America & Caribbean	-541,510.00
Indonesia	East Asia & Pacific	-282,193.98
Myanmar	East Asia & Pacific	-107,234.00
Nigeria	Sub-Saharan Africa	-106,506.00
Tanzania	Sub-Saharan Africa	-102,320.00

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	-59.27%
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 to 25%	85
25-50%	73
50-75%	38
75-100%	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**
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	87.5
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

4. RECOMMENDATIONS

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

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

Worldwide, forestation decreased between 1990 and 2016. The countries with the greatest decrease in forest area were in 2 regions - Sub-Saharan Africa and Latin America & the Caribbean. However, there were several countries that saw an increase in forest area during this time period. It would be interesting to investigate these countries further to discover why the forest area increased.

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

It would be interesting to focus on Nigeria, Togo, and Brazil which had the largest percent decrease in forest area and/or the largest total loss of forest area compared to other countries.

It would also be helpful to study Iceland, which had the largest percentage increase in forest area, to see what changes were made here to expand the forest area.

5. Appendix: SQL Queries

```
/*Create view*/
CREATE VIEW forestation
AS
SELECT f.country_code AS code, f.country_name AS name, f.year AS year,
f.forest_area_sqkm, l.total_area_sq_mi*2.59 AS total_area_sqkm,
(f.forest_area_sqkm/(total_area_sq_mi* 2.59))*100 AS percent_forest,
r.region AS region, r.income_group AS income_group
FROM forest_area f
JOIN land_area l
ON l.country_code=f.country_code AND l.year=f.year
LEFT JOIN regions r
ON r.country_code=l.country_code
ORDER BY l.country_name, l.year
```

1. Global Situation

```
/*Change since 1990*/
 SELECT year,
       new,
       LEAD(new) OVER (ORDER BY year) AS lead,
       LEAD(new) OVER (ORDER BY year) - new AS change,
       (LEAD(new) OVER (ORDER BY year) - new)/new *100  AS percent_change
FROM (
SELECT year,
       SUM(forest_area_sqkm) AS new
  FROM forestation
  WHERE YEAR IN (1990, 2016)
  AND name = 'World'
  AND forest_area_sqkm IS NOT NULL
 GROUP BY 1
) sub
```

```sql
/*Find country matching size of forest area lost*/
SELECT name, ROUND(total_area_sqkm::DECIMAL, 2)
FROM forestation
WHERE year = '2016'
AND total_area_sqkm < 1324449
ORDER BY total_area_sqkm DESC
LIMIT 1;
```

2. REGIONAL OUTLOOK

```sql
/*Table 2.1: Percent Forest Area by Region, 1990 & 2016:*/
WITH t1 AS (SELECT region, ROUND(AVG(percent_forest)::DECIMAL, 2) AVG_1990
            FROM forestation
            WHERE year = '1990'
            GROUP BY region),

t2 AS (SELECT region, ROUND(AVG(percent_forest)::DECIMAL, 2) AVG_2016
            FROM forestation
            WHERE year = '2016'
            GROUP BY region)
SELECT DISTINCT t1.region, t1.AVG_1990, t2.AVG_2016
FROM t1
JOIN t2
ON t1.region=t2.region
ORDER BY AVG_2016 DESC
```

3. COUNTRY-LEVEL DETAIL

A. Success stories

```
/*Success Stories: Top countries by TOTAL forest area*/
WITH t1 AS (SELECT name, ROUND(SUM(forest_area_sqkm)::DECIMAL,2) AS
forest_1990
            FROM forestation
            WHERE year = '1990'
            GROUP BY name),
t2 AS (SELECT name, ROUND(SUM(forest_area_sqkm)::DECIMAL,2) AS forest_2016
            FROM forestation
            WHERE year = '2016'
            GROUP BY name)
SELECT DISTINCT t1.name, t1.forest_1990, t2.forest_2016,
ROUND((t2.forest_2016-t1.forest_1990)::DECIMAL,2) AS difference
FROM t1
JOIN t2
ON t1.name=t2.name
WHERE t1.forest_1990 IS NOT NULL
AND t2.forest_2016 IS NOT NULL
ORDER BY difference DESC
LIMIT 2;
```

```
/*Success Stories: Top country by PERCENT forest area*/
WITH t1 AS (SELECT name, ROUND(AVG(percent_forest)::DECIMAL,2)  AS
forest_1990
            FROM forestation
            WHERE year = '1990'
            GROUP BY name
            HAVING ROUND(AVG(percent_forest)::DECIMAL,2) !=0),
t2 AS (SELECT name, ROUND(AVG(percent_forest)::DECIMAL,2) AS forest_2016
            FROM forestation
            WHERE year = '2016'
            GROUP BY name
            HAVING ROUND(AVG(percent_forest)::DECIMAL,2) !=0)
SELECT DISTINCT t1.name, t1.forest_1990, t2.forest_2016,
ROUND((t2.forest_2016-t1.forest_1990)/t1.forest_1990::DECIMAL,2) AS
percent_change
FROM t1
JOIN t2
ON t1.name=t2.name
WHERE t1.forest_1990 IS NOT NULL AND t2.forest_2016 IS NOT NULL
```

```
ORDER BY percent_change DESC
LIMIT 1;
```

B. Largest Concerns

```
/*Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016*/
WITH t1 AS (SELECT name, SUM(forest_area_sqkm) AS forest_1990
            FROM forestation
            WHERE year = '1990'
            GROUP BY name),
t2 AS (SELECT name, SUM(forest_area_sqkm) AS forest_2016
            FROM forestation
            WHERE year = '2016'
            GROUP BY name)
SELECT DISTINCT t1.name,
f.region,ROUND((t2.forest_2016-t1.forest_1990)::DECIMAL,2) AS difference
FROM t1
JOIN t2
ON t1.name=t2.name
JOIN forestation f
ON f.name=t1.name
WHERE region != 'World'
ORDER BY difference ASC
LIMIT 5;
```

```
/*Table 3.2: Top 5 Percent Decrease in Forest Area by Country,1990 &2016*/
WITH t1 AS (SELECT name, AVG(percent_forest) AS forest_1990
            FROM forestation
            WHERE year = '1990'
            GROUP BY name),
t2 AS (SELECT name, AVG(percent_forest) AS forest_2016
            FROM forestation
            WHERE year = '2016'
            GROUP BY name)
SELECT DISTINCT t1.name, f.region,
ROUND((((t2.forest_2016-t1.forest_1990)/t1.forest_1990)*100)::DECIMAL,2) AS
percent_difference
FROM t1
JOIN t2
ON t1.name=t2.name
JOIN forestation f
```

```
ON f.name=t1.name
ORDER BY percent_difference ASC
LIMIT 5;
```

C. Quartiles

```
/*Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles,
2016:*/
SELECT DISTINCT(quartiles), COUNT(name) OVER (PARTITION BY quartiles)
FROM
(SELECT name,
CASE WHEN percent_forest<=25 THEN '0 to 25%'
WHEN percent_forest<=50 AND percent_forest>25 THEN '25-50%'
WHEN percent_forest<=75 AND percent_forest>50 THEN '50-75%'
ELSE '75-100%'
END AS quartiles
FROM forestation
WHERE percent_forest IS NOT NULL AND year=2016) sub
ORDER BY quartiles
```

```
/*Table 3.4: Top Quartile Countries, 2016*/
SELECT name, region, ROUND(percent_forest :: DECIMAL, 2) percent_forest
FROM forestation
WHERE percent_forest >= 75
AND year = '2016'
ORDER BY percent_forest DESC
```