Report for ForestQuery into Global Deforestation, 1990 to 2016

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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 km^2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 km^2, a loss of 1,324,449 km^2, 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 km^2).

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 1: Forest area percentage by region in 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

3.1 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 km^2. 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 United States, but it only saw an increase of 79,200 km^2, much lower than the figure for China.

Table 2: Top 5 countries with the largest **absolute increase** in forest area from 1990 to 2016

Country	**Region**	**Absolute increase** (km^2)
China	East Asia & Pacific	527,229.06
United States	North America	79,200
India	South Asia	69,213.98
Russian Federation	Europe & Central Asia	59,395
Vietnam	East Asia & Pacific	55,390

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.

Table 3: Top 5 countries with the largest **percentage increase** in forest area from 1990 to 2016

Country	**Region**	**Percentage increase** (%)
Iceland	Europe & Central Asia	213.66
French Polynesia	East Asia & Pacific	181.82
Bahrain	Middle East & North Africa	177.27
Uruguay	Latin America & Caribbean	134.11
Dominican Republic	Latin America & Caribbean	82.46

3.2 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 5 countries had the largest decrease in forest area over the time period under consideration:

Table 4: Top 5 countries with the largest **absolute decrease** in forest area from 1990 to 2016

Country	**Region**	**Absolute decrease** (km^2)
Brazil	Latin America & Caribbean	541,510
Indonesia	East Asia & Pacific	282,193.98
Myanmar	East Asia & Pacific	107,234
Nigeria	Sub-Saharan Africa	106,506
Tanzania	Sub-Saharan Africa	102,320

The second way to consider which countries are of concern is to analyze the data by percent decrease.

Table 5: Top 5 countries with the largest **percentage decrease** in forest area from 1990 to 2016

Country	**Region**	**Percentage decrease** (%)
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 challenge ahead to stop the decline and hopefully spearhead remedial efforts.

3.3 Quartiles

The largest number of countries in 2016 were found in the 0-25% forestation percent quartile.

Table 6: Count of countries grouped by forestation percent quartiles in 2016

Quartile (%)	Number of Countries
0-25	85
25-50	72
50-75	38
75-100	9

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 7: Top quartile (75-100%) countries in 2016

Country	Region	Forest Percentage (%)
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

The World Bank data clearly shows the presence of deforestation around the world. It is also evident that not all regions in the world were affected in the same way. In this report, I have outlined the success stories of the past 20 years, highlighting that countries like China, United States and Iceland have actually increased their forest area while countries in Sub-Saharan Africa suffered the most. However, the entirety of the globe has lost the forest area equivalent to the land of Peru, and this should be a global concern rather than a local one. Thus, my recommendation is that the efforts should primarily focus on countries like Togo or Nigeria, which lost the most forest area in relative terms, as stopping deforestation in those areas should be the main short term

goal. However, the situation could also worsen in the Latin America Caribbean region as Brazil loses the most of forest area in absolute terms and hence, this region should also be considered in the long term.

5 Appendix (SQL queries)

Creating initial view.

```sql
/* Drop VIEW if it already exists */
DROP VIEW IF EXISTS forestation;

/* Creating the view */
CREATE VIEW forestation AS
SELECT fa.country_code, fa.country_name country,
  fa.year, fa.forest_area_sqkm forest_area,
  (la.total_area_sq_mi * 2.59) total_land_area,
  r.region, r.income_group income_group,
  100 * (fa.forest_area_sqkm /
  (la.total_area_sq_mi * 2.59)) AS foreset_land_percent
FROM forest_area fa
JOIN land_area la
ON fa.country_code = la.country_code AND fa.year = la.year
JOIN regions r
ON r.country_code = la.country_code;
/* Converted total area from miles to km for unit consistency */

/* Checking the results */
SELECT * FROM forestation;
```

5.1 Global situation

a) The total forest area (in sq km) of the world in 1990.

```sql
SELECT forest_area
FROM forestation
WHERE year = 1990 AND region = 'World';
```

b) The total forest area (in sq km) of the world in 2016.

```sql
SELECT forest_area
FROM forestation
WHERE year = 2016 AND region = 'World';
```

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

```sql
SELECT now.forest_area - prev.forest_area difference
FROM forestation now
JOIN forestation prev
ON (now.year = 2016 AND prev.year = 1990
  AND now.region = 'World' AND prev.region = 'World');

/* Additional query to check the calculation manually */
SELECT forest_area
FROM forestation
WHERE region = 'World' AND (year = 2016 OR year = 1990);
```

d) The percent change in forest area of the world between 1990 and 2016.

```sql
SELECT 100 * (now.forest_area - prev.forest_area) / prev.forest_area difference
FROM forestation now
JOIN forestation prev
ON (now.year = 2016 AND prev.year = 1990
  AND now.region = 'World' AND prev.region = 'World');
```

e) Comparing the amount of forest area lost between 1990 and 2016 to total areas of countries in 2016.

```sql
/* Checking the closest value less than the lost area */
SELECT country, total_land_area
FROM forestation
WHERE year = 2016 AND (total_land_area <
  ABS((SELECT x.forest_area - y.forest_area difference
    FROM forestation x
    JOIN forestation y
    ON (x.year = 1990 AND y.year = 2016
      AND x.region = 'World' AND y.region = 'World'))))
ORDER BY 2 DESC
LIMIT 1;

/* Checking the closest value more than the lost area */
SELECT country, total_land_area
FROM forestation
WHERE year = 2016 AND (total_land_area >
  ABS((SELECT x.forest_area - y.forest_area difference
```

```
    FROM forestation x
    JOIN forestation y
    ON (x.year = 1990 AND y.year = 2016
      AND x.region = 'World' AND y.region = 'World'))))
ORDER BY 2
LIMIT 1;

/* Additional query to manually check area values */
SELECT country, total_land_area
FROM forestation
WHERE year = 2016
ORDER BY total_land_area;
```

5.2 Regional Outlook

Creating a new table for regional outlook.

```
/* Drop TABLE if it already exists */
DROP TABLE IF EXISTS region_outlook;

/* Creating the table */
CREATE TABLE region_outlook AS
  SELECT region, year, ROUND(CAST(100 * (SUM(forest_area) / SUM(total_land_area))
  AS NUMERIC),2) AS region_forest_percent
FROM forestation
GROUP BY 1,2
ORDER BY 2;

/* Checking the results */
SELECT * FROM region_outlook;
```

a)
Forest land as a percentage of the entire world in 2016.

```
SELECT region_forest_percent
FROM region_outlook
WHERE year = 2016 AND region = 'World';
```

Region with the highest percent of forestation in 2016, and with the lowest percent of forestation.

```sql
/* Highest percent of forestation */
SELECT region, region_forest_percent
FROM region_outlook
WHERE year = 2016 AND region != 'World'
ORDER BY 2 DESC
LIMIT 1;

/* Lowest percent of forestation */
SELECT region, region_forest_percent
FROM region_outlook
WHERE year = 2016 AND region != 'World'
ORDER BY 2
LIMIT 1;
```

b)
Forest land as a percentage of the entire world in 1990.

```sql
SELECT region_forest_percent
FROM region_outlook
WHERE year = 1990 AND region = 'World';
```

Region with the highest percent of forestation in 1990, and with the lowest percent of forestation.

```sql
/* Highest percent of forestation */
SELECT region, region_forest_percent
FROM region_outlook
WHERE year = 1990 AND region != 'World'
ORDER BY 2 DESC
LIMIT 1;

/* Lowest percent of forestation */
SELECT region, region_forest_percent
FROM region_outlook
WHERE year = 1990 AND region != 'World'
ORDER BY 2
LIMIT 1;
```

c) Comparing forest area for all regions in 2016 and 1990.

```sql
SELECT x.region, x.region_forest_percent forestation_1990,
  y.region_forest_percent forestation_2016
```

```
FROM region_outlook x
JOIN region_outlook y
ON x.region = y.region
WHERE  x.year = 1990 AND x.region != 'World'
  AND y.year = 2016 AND y.region != 'World'
ORDER BY 2 DESC;
```

5.3 Country-Level Detail

5.3.1 Success Stories

a) Top 5 countries that saw the largest amount increase in forest area from 1990 to 2016.

```
SELECT now.country, now.region,
  now.forest_area - prev.forest_area difference
FROM forestation now
JOIN forestation prev
ON now.year = 2016 AND prev.year = 1990 AND now.country = prev.country
WHERE (now.forest_area - prev.forest_area) IS NOT NULL
ORDER BY 3 DESC
LIMIT 5;
```

b) Top 5 countries that saw the largest percentage increase in forest area from 1990 to 2016.

```
SELECT now.country, now.region,
  ROUND(CAST(((now.forest_area - prev.forest_area) / prev.forest_area * 100)
  AS NUMERIC), 2) percentage_difference
FROM forestation now
JOIN forestation prev
ON now.year = 2016 AND prev.year = 1990 AND now.country = prev.country
WHERE (now.forest_area - prev.forest_area) IS NOT NULL
ORDER BY 3 DESC
LIMIT 5;
```

5.3.2 Largest Concerns

c) Top 5 countries that saw the largest amount decrease in forest area from 1990 to 2016.

```sql
SELECT now.country, now.region,
  now.forest_area - prev.forest_area difference
FROM forestation now
JOIN forestation prev
ON now.year = 2016 AND prev.year = 1990 AND now.country = prev.country
WHERE (now.forest_area - prev.forest_area) IS NOT NULL
  AND now.country != 'World'
ORDER BY 3
LIMIT 5;
```

d) Top 5 countries that saw the largest percentage decrease in forest area from 1990 to 2016.

```sql
SELECT now.country, now.region,
  ROUND(CAST(((now.forest_area - prev.forest_area) / prev.forest_area * 100)
  AS NUMERIC), 2) percentage_difference
FROM forestation now
JOIN forestation prev
ON now.year = 2016 AND prev.year = 1990 AND now.country = prev.country
WHERE (now.forest_area - prev.forest_area) IS NOT NULL
  AND now.country != 'World'
ORDER BY 3
LIMIT 5;
```

5.3.3 Quartiles

e) Countries grouped by percent forestation in quartiles.

```sql
SELECT distinct(quartiles), COUNT(country) OVER (PARTITION BY quartiles)
FROM (SELECT country,
    CASE WHEN foreset_land_percent <= 25 THEN '0-25'
    WHEN foreset_land_percent <= 50 AND foreset_land_percent > 25 THEN '25-50'
    WHEN foreset_land_percent <= 75 AND foreset_land_percent > 50 THEN '51-75'
    ELSE '75-100' END AS quartiles
  FROM forestation
  WHERE foreset_land_percent IS NOT NULL
  AND year = 2016 AND country != 'World') sub
ORDER BY quartiles;
```

f) Top quartile (75-100%) countries in 2016.

```sql
SELECT country, region, ROUND(CAST(foreset_land_percent AS NUMERIC),2)
FROM forestation
WHERE foreset_land_percent > 75 AND year = 2016
ORDER BY 3 DESC;
```