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 41,282,695 sq.km. in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,246 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 1,280,000 sq.km.).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 31.31%. 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 32.0%. 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	Difference
Latin America & Caribbean	51.03	46.16	-4.87
Europe & Central Asia	37.28	38.04	0.76
North America	35.65	36.04	0.39
Sub-Saharan Africa	30.67	28.79	-1.88
East Asia & Pacific	25.78	26.36	0.58
South Asia	16.51	17.51	1
Middle East & North Africa	1.78	2.07	0.29

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 32.00% to 31.31%.

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 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 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:

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
Indonesia	East Asia & Pacific	-282'194
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 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	-61.8
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 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

From the World Bank data we have learned that, from 1990 to 2016, the total forest area of the world decreased by 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 (1,280,000 sq.km.), which is the 19th largest country in the world, and the third largest in South America.

Brazil (Latin America & Caribbean region), Indonesia, Myanmar (East Asia & Pacific region) and Nigeria, Tanzania (Sub-Saharan Africa region) are the highest ranked countries with regard to the forest area decrease in absolute terms (sq.km).

It is important to note that Brazil with the highest forest area decrease of 541'510 sq.km, is the biggest country in the Latin America & Caribbean region. The Latin America & Caribbean is in turn the region with the highest percentage of the land area designated as forest, accounting for 51% as per 2016 World Bank data. Therefore, Brazil would require special attention to the problem of deforestation.

Other regions with high percentage of the land area designated as forest have seen quite significant drop of forest area as well. These regions include Europe & Central Asia, North America, Sub-Saharan Africa and East Asia & Pacific.

On a positive note, big countries with high forest area have seen increase in forest area from 1990 to 2016. It is worth studying the best experience of these countries and share it with countries that have seen significant decrease in the forest area. Especially, countries from Sub-Saharan Africa region, with the highest percent decrease in forest area, would need greater assistance to support them in developing policing to fight deforestation.

Countries need to cooperate closely to fight against the deforestation as it is a matter of important common interest and goals. Close cooperation, innovation, research and development could be the way forward in addressing the deforestation issue faced by the countries and regions.

5. APPENDIX: SQL Queries Used

CREATE A VIEW "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 * 2.59) AS land_area_sqkm, r.region, r.income_group
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);
```

GLOBAL SITUATION

```
WITH glob_1990 AS
    (SELECT region, year, forest_area_sqkm, land_area_sqkm
    FROM forestation
    WHERE region = 'World' AND year ='1990'),
    glob_2016 AS
    (SELECT region, year, forest_area_sqkm, land_area_sqkm
    FROM forestation
    WHERE region = 'World' AND year ='2016')
SELECT
glob_1990.region,
ROUND(glob_1990.forest_area_sqkm) AS forest_sqkm_1990,
ROUND(glob_2016.forest_area_sqkm) AS forest_sqkm_2016,
ROUND((glob_2016.forest_area_sqkm - glob_1990.forest_area_sqkm)::numeric)
AS diff_forest_sqkm,
ROUND(((glob_2016.forest_area_sqkm -
glob_1990.forest_area_sqkm)*100/glob_1990.forest_area_sqkm)::numeric,2) AS
diff_forest_percent
FROM glob_2016, glob_1990;
```

The forest area lost over this time period is slightly more than the entire land area of …

```
SELECT country_name, year, ROUND(land_area_sqkm)
FROM forestation
WHERE year = '2016' AND land_area_sqkm >=1200000 AND land_area_sqkm
<1600000
ORDER BY land_area_sqkm DESC;
```

----- REGIONAL OUTLOOK TOTAL --------

```
WITH total_sqkm AS
    (SELECT year, ROUND(SUM(forest_area_sqkm)::numeric,2) AS
total_forest_sqkm, ROUND(SUM(land_area_sqkm)::numeric,2) AS
total_land_sqkm
    FROM forestation
    WHERE year IN ('1990', '2016') AND region!='World'
    GROUP BY year)
SELECT year,
ROUND(SUM(total_forest_sqkm)) AS total_forest_sqkm,
ROUND(SUM(total_land_sqkm)) AS total_land_sqkm,
ROUND ((SUM(total_forest_sqkm)/SUM(total_land_sqkm)*100)::numeric,2) AS
total_forest_percent
FROM total_sqkm
GROUP BY year;
```

----- REGIONAL OUTLOOK Table 2.1: Percent Forest Area by Region ----

```
WITH t_1990 AS
    (SELECT region,
    ROUND(((SUM(forest_area_sqkm)/SUM(land_area_sqkm))*100)::numeric,2) AS
forest_percent_1990
    FROM forestation
    WHERE year='1990' and region!='World'
    GROUP BY region),
    t_2016 AS
    (SELECT region,
    ROUND(((SUM(forest_area_sqkm)/SUM(land_area_sqkm))*100)::numeric,2) AS
forest_percent_2016
    FROM forestation
    WHERE year='2016' and region!='World'
    GROUP BY region)
SELECT t_1990.region, forest_percent_1990, forest_percent_2016,
(forest_percent_2016-forest_percent_1990) AS diff
FROM t_1990
JOIN t_2016
ON t_1990.region=t_2016.region;
```

----- COUNTRY LEVEL ----

```
WITH t_1990 AS
    (SELECT country_name, ROUND(forest_area_sqkm) AS forest_sqkm
    FROM forestation
    WHERE year='1990' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY country_name, forest_area_sqkm),
    t_2016 AS
    (SELECT country_name, ROUND(forest_area_sqkm) AS forest_sqkm
    FROM forestation
    WHERE year='2016' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY country_name, forest_area_sqkm)

SELECT t_1990.country_name,
t_1990.forest_sqkm AS forest_sqkm_1990,
t_2016.forest_sqkm AS forest_sqkm_2016,
(t_2016.forest_sqkm - t_1990.forest_sqkm) AS diff_forest_sqkm,
ROUND((((t_2016.forest_sqkm -
t_1990.forest_sqkm)/t_1990.forest_sqkm)*100)::numeric,2) AS
diff_forest_percent
FROM t_1990
JOIN t_2016
ON t_1990.country_name=t_2016.country_name
ORDER BY diff_forest_sqkm DESC;
```

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

```
WITH t_1990 AS
    (SELECT region, country_name, ROUND(forest_area_sqkm) AS forest_sqkm
    FROM forestation
    WHERE year='1990' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY region, country_name, forest_area_sqkm),
    t_2016 AS
    (SELECT region, country_name, ROUND(forest_area_sqkm) AS forest_sqkm
    FROM forestation
    WHERE year='2016' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY region, country_name, forest_area_sqkm)

SELECT t_1990.country_name, t_1990.region,
```

```
(t_2016.forest_sqkm - t_1990.forest_sqkm) AS diff_forest_sqkm
FROM t_1990
JOIN t_2016
ON t_1990.country_name=t_2016.country_name
ORDER BY diff_forest_sqkm
LIMIT 5;
```

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

```
WITH t_1990 AS
    (SELECT region, country_name, ROUND(forest_area_sqkm) AS forest_sqkm
    FROM forestation
    WHERE year='1990' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY region, country_name, forest_area_sqkm),
    t_2016 AS
    (SELECT region, country_name, ROUND(forest_area_sqkm) AS  forest_sqkm
    FROM forestation
    WHERE year='2016' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY region, country_name, forest_area_sqkm)
```

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

```
SELECT country_name,
ROUND(((SUM(forest_area_sqkm)/SUM(land_area_sqkm))*100)::numeric,2) AS
forest_percent_2016
FROM forestation
WHERE year='2016' AND country_name!='World' AND forest_area_sqkm IS NOT
NULL AND land_area_sqkm IS NOT NULL
GROUP BY country_name
ORDER BY forest_percent_2016
```

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

```
WITH t1 AS
    (SELECT country_name,
    ROUND(((SUM(forest_area_sqkm)/SUM(land_area_sqkm))*100)::numeric,2) AS
forest_percent_2016
    FROM forestation
```

```
    WHERE year='2016' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY country_name
    ORDER BY forest_percent_2016),

    qrt AS
    (SELECT t1.country_name, t1.forest_percent_2016,
    CASE
        WHEN forest_percent_2016 >= 75 THEN '75-100'
        WHEN forest_percent_2016 >=50 THEN '50-75'
        WHEN forest_percent_2016 >=25 THEN '25-50'
        ELSE '0-25'
    END AS quartile
    FROM t1
    GROUP BY t1.country_name, t1.forest_percent_2016)
SELECT qrt.quartile, COUNT (*)
FROM qrt
GROUP BY qrt.quartile
ORDER BY qrt.quartile;
```

Table 3.4: Top Quartile Countries, 2016:

```
WITH t1 AS
    (SELECT country_name, region,
    ROUND(((SUM(forest_area_sqkm)/SUM(land_area_sqkm))*100)::numeric,2) AS
forest_percent_2016
    FROM forestation
    WHERE year='2016' AND country_name!='World' AND forest_area_sqkm IS
NOT NULL AND land_area_sqkm IS NOT NULL
    GROUP BY country_name, region
    ORDER BY forest_percent_2016)
SELECT t1.country_name, t1.region, t1.forest_percent_2016
FROM t1
WHERE t1.forest_percent_2016 >=75
ORDER BY t1.forest_percent_2016 DESC;
```