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 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 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 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%
World	32.42%	31.38%
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 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.

Russian Federation 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 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 sq km
Indonesia	East Asia & Pacific	282,194 sq km
Myanmar	East Asia & Pacific	107,234 sq km
Nigeria	Sub-Saharan Africa	106,506 sq km
Tanzania	Sub-Saharan Africa	102,320 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 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
1	85
2	72
3	38
4	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	87.50%
Guyana	Latin America & Caribbean	83.90%
Lao PDR	East Asia & Pacific	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?*

Deforestation has been seen as a global environmental issue due to the fact that the total forest area of the world shrank from 41,282,694.9 square kilometers (sq km) in 1990 to 39,958,245.9 sq km in 2016, representing a 3.21% loss. The percent relative size of forest to total land area of the world also declined from 32.42% to 31.38% during the same time period.

Looking at the regional level, Latin America & Caribbean was the area with the highest relative forestation in both 1990 and 2016, although there was a slight decrease (dropped from 51.03% to 46.16%). Followed by was Europe & Central Asia which had a 37.28% forestation in 1990 and that increased to 38.04% by 2016. Sub-Saharan Africa was the other region among the total seven saw a decrease in relative forestation (dropped from 30.67% to 28.19%).

Diving deeply into the specific country level, despite the abundance in forest in Latin America, Brazil's forest area dropped 541,510 sq km, the worst across the world. The most concerning area was Sub-Saharan Africa given that four of the top five countries experienced most severe percent decrease in forest area between 1990 and 2016 lie in this region – Togo (-75%), Nigeria (-62%), Uganda (-59%), and Mauritania (-47%). Nigeria was also on the top absolute amount decrease list.

China was the absolute bright spot in the data as the country's forest area actually increased by 527,229 sq km between 1990 and 2016. The U.S. was the second-best performer with a 79,200 sq km forest area increase.

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

Given the above Word Bank data, immediate efforts should be taken to tackle the most concerning Sub-Saharan African countries, namely Nigeria, Togo, Uganda, Mauritania, and Tanzania.

Besides, Brazil should also be starting to make plans to mitigate the decline in forest area. East Asia & Pacific should focus on Indonesia and Myanmar as these two countries showed severe deforestation during the study period (282,194 sq km and 107,234 sq km drop respectively).

It would be worth to study the environmental protection efforts that China and the U.S. had made to drive the size in forest area.

Appendix

Preparation: Create View deforestation:

```
CREATE VIEW forestation AS
SELECT
    f.country_code,
    f.country_name,
    f.year,
    f.forest_area_sqkm AS forest_area,
    l.total_area_sq_mi AS land_area,
    (f.forest_area_sqkm*100)/(l.total_area_sq_mi*2.59) AS forest_area_pct,
    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;
```

Part 1: GLOBAL SITUATION

1.a – Total forest area (in sq km) of the world in 1990

```
SELECT
    country_name,
    year,
    forest_area
FROM forestation
WHERE country_name = 'World'
AND year = '1990';
```

1.b – Total forest area (in sq km) of the world in 2016

```
SELECT
    country_name,
    year,
    forest_area
FROM forestation
WHERE country_name = 'World'
AND year = '2016';
```

1.c + d – Change (in sq km) and percent change in forest area of the world from 1990 to 2016

```
WITH world_2016 AS(
    SELECT forest_area forest_area_2016
    FROM forestation
    WHERE country_name = 'World'
    AND year = '2016'),

world_1990 AS (
    SELECT forest_area AS forest_area_1990
    FROM forestation
    WHERE country_name = 'World'
    AND year = '1990')

SELECT
    forest_area_1990 - forest_area_2016 AS forest_area_change,
    ROUND(CAST((forest_area_1990 - forest_area_2016 )/forest_area_1990*100 AS
Numeric),2) AS change_pct
FROM  world_2016, world_1990;
```

1.e – If you compare the amount of forest area lost between 1990 and 2016, to which country's total area in 2016 is it closest to?

```
  SELECT
      country_name,
      ROUND(CAST(land_area*2.59 AS Numeric), 2) AS land_area,
      ROUND(CAST(ABS (land_area*2.59 - 1324449) AS Numeric),2) AS
area_difference
  FROM forestation
  WHERE year = '2016'
  ORDER BY 3
  LIMIT 1;
```

Part 2 – REGIONAL OUTLOOK

2.a + b + c

a. percent forest of the entire world in 2016, the region with the highest /lowest percent forest in 2016

b. percent forest of the entire world in 1990, the region with the highest /lowest percent forest in 1990

c. the regions of the world experienced decrease in forest area from 1999 to 2016

```
CREATE Table regional_outlook AS(
    SELECT
        region,
        ROUND(CAST(SUM(CASE WHEN year='1990' THEN forest_area*100
END)/SUM(CASE WHEN year='1990' THEN land_area*2.59 END) AS Numeric),2) AS
pct_forest_area_1990,
        ROUND(CAST(SUM(CASE WHEN year='2016' THEN forest_area*100
END)/SUM(CASE WHEN year='2016' THEN land_area*2.59 END) AS Numeric),2) AS
pct_forest_area_2016
    FROM forestation
    GROUP BY 1);

SELECT * FROM regional_outlook
ORDER BY 3 DESC;
```

Part 3 – COUNTRY-LEVEL DETAIL

A. Success Stories

Absolute Changes in forest area:

```
WITH t1 AS(
    SELECT
        country_name AS country,
        region AS region,
        SUM(CASE WHEN year='1990' THEN forest_area END) AS forest_area_1990,
        SUM(CASE WHEN year='2016' THEN forest_area END) AS forest_area_2016
    FROM forestation
    GROUP BY 1,2
)
SELECT
    country,
    region,
    ROUND(CAST(forest_area_1990 - forest_area_2016 AS Numeric),0) AS
amt_diff_1990_to_2016
FROM t1
WHERE country != 'World'
ORDER BY 3;
```

Percent Changes in forest area:

Largest land area:

```
SELECT country_name, SUM(land_area)
FROM forestation
    WHERE country_name <> 'World'
    AND land_area IS NOT NULL
GROUP BY 1
ORDER BY 2 DESC;
```

percent change in forest area from 1990 to 2016:

```
WITH t1 AS
(
    SELECT country_name, forest_area
    FROM forestation
    WHERE year = '1990'
    AND forest_area IS NOT NULL
),

t2 AS
(
    SELECT country_name, forest_area
    FROM forestation
    WHERE year = '2016'
    AND forest_area IS NOT NULL
)

SELECT
    t1.country_name,
    ROUND(CAST((t2.forest_area - t1.forest_area)/t1.forest_area*100 AS
Numeric),2) AS pct_diff_1990_to_2016
FROM t1 INNER JOIN t2
    ON t1.country_name = t2.country_name
ORDER BY 2 DESC
LIMIT 1;
```

B. Largest Concerns

3.a – Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?

```
WITH t1 AS(
    SELECT
        country_name AS country,
        region AS region,
        SUM(CASE WHEN year='1990' THEN forest_area END) AS forest_area_1990,
        SUM(CASE WHEN year='2016' THEN forest_area END) AS forest_area_2016
    FROM forestation
    GROUP BY 1,2
)

SELECT
    country,
    region,
    ROUND(CAST(forest_area_1990 - forest_area_2016 AS Numeric),0) AS
amt_diff_1990_to_2016
FROM t1
WHERE forest_area_1990 > forest_area_2016
AND country != 'World'
ORDER BY 3 DESC
LIMIT 5;
```

3.b – Which 5 countries saw the largest percent decrease in forest area from 1990 to 2016? What was the percent change to 2 decimal places for each?

```
WITH t1 AS(
    SELECT
        country_name AS country,
        region AS region,
        SUM(CASE WHEN year='1990' THEN forest_area END) AS forest_area_1990,
        SUM(CASE WHEN year='2016' THEN forest_area END) AS forest_area_2016
    FROM forestation
    GROUP BY 1,2
)

SELECT
    country,
    region,
    ROUND(CAST((forest_area_1990-forest_area_2016)/forest_area_1990*100 AS
Numeric),2) AS pct_diff_1990_to_2016
FROM t1
WHERE forest_area_1990 > forest_area_2016
AND country != 'World'
ORDER BY 3 DESC
LIMIT 5;
```

C. Quartiles

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:
3.c – If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
SELECT
    SUM(CASE WHEN forest_area_pct>=0 AND forest_area_pct<25 THEN 1 END) AS
first_quartile,
    SUM(CASE WHEN forest_area_pct>=25 AND forest_area_pct<50 THEN 1 END) AS
second_quartile,
    SUM(CASE WHEN forest_area_pct>=50 AND forest_area_pct<75 THEN 1 END) AS
third_quartile,
    SUM(CASE WHEN forest_area_pct>=75 THEN 1 END) AS fourth_quartile
FROM forestation
WHERE year = '2016'
    AND forest_area_pct IS NOT NULL
    AND country_name != 'World';
```

Table 3.4: Top Quartile Countries, 2016:
3.d – List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016:

```
SELECT
    country_name AS country,
    region,
    ROUND(CAST(forest_area_pct AS Numeric), 2) AS pct_designated_as_forest
FROM forestation
WHERE forest_area_pct>=75
    AND year = '2016'
ORDER BY 3 DESC;
```

3.e – How many countries had a percent forestation higher than the United States in 2016?

```
WITH t1 AS
(
    SELECT country_name, forest_area_pct
    FROM forestation
    WHERE forest_area_pct > (
        SELECT forest_area_pct FROM forestation
        WHERE country_name = 'United States'
      AND year = '2016'
    )
    AND year = '2016'
)

SELECT COUNT(country_name) FROM t1;
```