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 41282694.9 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9, a loss of 1324449, 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).

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 the 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 the 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

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 33.5%. 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 theUnited States, but it only saw an increase of 2.62%, 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 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
Brazil	Latin America & Caribbean	-541510
Indonesia	East Asia & Pacific	-282193.98
Myanmar	East Asia & Pacific	-107234
Nigeria	Sub-Saharan Africa	-106506
Tanzania	Sub-Saharan Africa	-102320

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 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
1	85
2	73
3	38
4	9

The largest number of countries in 2016 were found in the 1st 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 (%)
Solomon Islands	East Asia & Pacific	77.86
Lao PDR	East Asia & Pacific	82.11
Guyana	Latin America & Caribbean	83.90
American Samoa	East Asia & Pacific	87.50

Palau	East Asia & Pacific	87.61
Seychelles	Sub-Saharan Africa	88.41
Gabon	Sub-Saharan Africa	90.04
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Suriname	Latin America & Caribbean	98.26

4. RECOMMENDATIONS

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

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

Globally, between 1990 and 2016 the proportion of forest land decreased by 3.31%. This is equivalent to the land mass of Peru. The situation is masked by regional variations, with most continents actually slightly increasing the proportion of land given to forests. These hard won gains however, were offset by Sub-Saharan Africa and Latin America & Caribbean, where the rate of deforestation played a significant role in the deteriorating situation.

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

Nigeria saw some of the largest declines in forest land (in absolute and relative terms). It therefore presents the single greatest opportunity to achieve the "best bang for your buck". Brazil and Indonesia, home to two of the world's most diverse ecosystems, should also be targeted for focussed intervention.

5. APPENDIX

```
/*
Global Situation
*/

/*
Build a view that joins all three tables that  will serve as a single source of truth
*/
CREATE VIEW
	forestation AS
SELECT f.country_code, f.country_name, r.region, r.income_group, f.year, f.forest_area_sqkm,
		l.total_area_sq_mi, l.total_area_sq_mi*2.59  AS total_area_sq_km,
		(f.forest_area_sqkm / (l.total_area_sq_mi*2.59) * 100) AS percent_forest
FROM forest_area f
JOIN land_area l
	ON f.country_code = l.country_code
   AND f.year = l.year
JOIN regions r
	ON l.country_code = r.country_code;
/*
What was the total forest area (in sq km) of the world in 1990?
*/
SELECT *
FROM forestation
WHERE country_name = 'World'
	AND year = 1990;

/*
What was the total forest area (in sq km) of the world in 2016?
*/
SELECT *
FROM forestation
WHERE country_name = 'World'
	AND year = 2016;

/*
What was the change (in sq km) in the forest area of the world from 1990 to 2016?
*/
SELECT *,
		LAG(forest_area_sqkm) OVER (ORDER BY country_name) AS
difference,
```

```
      LAG(forest_area_sqkm) OVER (ORDER BY country_name) -forest_area_sqkm AS
forestarea_diff_1990_2016
FROM forestation
WHERE country_name = 'World'
        AND year = 1990
OR country_name = 'World'
   AND year = 2016;

/*
What was the percent change in forest area of the world between 1990 and 2016?
*/
SELECT A.country_name, A.forest_area_sqkm forest_area_1990, B.forest_area_sqkm
forest_area_2016, (B.forest_area_sqkm - A.forest_area_sqkm) forest_difference
FROM forestation A, forestation B
WHERE A.year=1990 AND B.year=2016 AND A.country_name=B.country_name AND
A.country_name='World'

/*
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 *
FROM forestation
WHERE year = 2016
AND total_area_sq_km IS NOT NULL
ORDER BY total_area_sq_km DESC;

/*
Regional Outlook
*/

/*
Create a table that groups countries by region and calculates percent of area given to forest
*/
CREATE VIEW
        regional_outlook AS
SELECT region, year, SUM(forest_area_sqkm) sum_forest_area, SUM(total_area_sq_km)
sum_total_area,
                ((SUM(forest_area_sqkm) / SUM(total_area_sq_km)) * 100) AS percent_forest
FROM forestation
WHERE year = 1990 OR year = 2016
GROUP BY region, year
ORDER BY region, year;
```

```
/*
What was the percent forest of the entire world in 2016? 31.375 Which region had the
HIGHEST percent forest in 2016 Latin America & Caribbean 46.16 , and which had the
LOWEST Middle East & North Africa 2.068, to 2 decimal places?
*/
SELECT *
FROM regional_outlook
WHERE year = 2016
ORDER BY percent_forest;

/*
What was the percent forest of the entire world in 1990? 32.42 Which region had the HIGHEST
percent forest in 1990 Latin America & Caribbean 51.029, and which had the LOWEST Middle
East & North Africa 1.775, to 2 decimal places?
*/
SELECT *
FROM regional_outlook
WHERE year = 1990
ORDER BY percent_forest;

/*
Based on the table you created, which regions of the world DECREASED in forest area from
1990 to 2016?
*/
SELECT *,
LAG(sum_forest_area) OVER (PARTITION BY region ORDER BY region, year DESC) AS
        difference,
    LAG(sum_forest_area) OVER (PARTITION BY region ORDER BY region, year DESC) -
sum_forest_area AS forestarea_diff_1990_2016

FROM regional_outlook;


/*
Country-Level Detail
*/

/*
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 sub AS (
```

```
SELECT country_name, year, forest_area_sqkm
FROM forestation
WHERE year = 1990 OR year = 2016
ORDER BY country_name, year)

SELECT country_name, year, forest_area_sqkm,
                LAG(forest_area_sqkm) OVER (PARTITION BY country_name ORDER BY
country_name) AS forest_area_1990,
      forest_area_sqkm - LAG(forest_area_sqkm) OVER (PARTITION BY country_name
ORDER BY country_name) AS forestarea_diff_1990_2016
FROM sub
ORDER BY forestarea_diff_1990_2016 ASC;

/*
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?
*/
CREATE VIEW
        crosstab_forestarea1990 AS
WITH sub AS (
SELECT country_name, year, forest_area_sqkm
FROM forestation
WHERE year = 1990 OR year = 2016
ORDER BY country_name, year)

SELECT country_name, year, forest_area_sqkm,
                LAG(forest_area_sqkm) OVER (PARTITION BY country_name ORDER BY
country_name) AS forest_area_1990,
      forest_area_sqkm - LAG(forest_area_sqkm) OVER (PARTITION BY country_name
ORDER BY country_name) AS forestarea_diff_1990_2016
FROM sub
ORDER BY forestarea_diff_1990_2016 ;

SELECT *,
                ((forest_area_sqkm - forest_area_1990) / (forest_area_1990) *
100) AS percent_change
FROM crosstab_forestarea1990
WHERE forestarea_diff_1990_2016 IS NOT NULL
ORDER BY percent_change DESC;


/*
```

```
If countries were grouped by percent forestation in quartiles, which group had the most
countries in it in 2016?
*/
CREATE VIEW
        quartiles AS
SELECT *, CASE
                        WHEN percent_forest < 25 THEN '1'
                        WHEN percent_forest >= 25 AND percent_forest < 50 THEN '2'
                        WHEN percent_forest >= 50 AND percent_forest < 75 THEN '3'
                        ELSE '4'
                        END quartiles
FROM (SELECT *
                                FROM forestation
                                WHERE year = 2016
                                 AND percent_forest IS NOT NULL) sub;

SELECT quartiles, COUNT(*)
FROM quartiles
GROUP BY quartiles;

/*
List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016
*/
CREATE VIEW
        quartiles AS
SELECT *, CASE
                        WHEN percent_forest < 25 THEN '1'
                        WHEN percent_forest >= 25 AND percent_forest < 50 THEN '2'
        WHEN percent_forest >= 50 AND percent_forest < 75 THEN '3'
        ELSE '4'
        END quartiles
FROM (SELECT *
                                FROM forestation
                                WHERE year = 2016
                                 AND percent_forest IS NOT NULL) sub;

SELECT *
FROM quartiles
WHERE quartiles = '4'


/*
How many countries had a percent forestation higher than the United States in 2016?
```

```
*/
SELECT *
FROM forestation
WHERE year = 2016
        AND percent_forest >
(SELECT percent_forest
FROM forestation
WHERE country_name = 'United States'
        AND year = 2016);
```