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 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 1324449.0 sq.km, or 3.208242589.0%.

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 sq.km).

2. REGIONAL OUTLOOK

In 2016, the percentage 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 percentage 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 50.03%, 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
World	32.42	31.38
Sub-Saharan Africa	30.67	28.79
South Asia	16.51	17.51
North America	35.65	36.04
Middle East & North Africa	1.78	2.07
Latin America & Caribbean	51.03	46.16
Europe & Central Asia	37.28	38.04
East Asia & Pacific	25.78	26.36

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 (dropped from 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 33.55%. 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 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's forest area increased 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	SQ/KM 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	61.80
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
Q1	85
Q2	72
Q3	38
Q4	9

The largest number of countries in 2016 were found in the first quartile.

There were 85 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

The relationship between income level and deforestation by country is one component of the data that has not been explored in this analysis. The four income categories detected in the deforestation dataset are listed below:

Table 5.1: Counts of countries by Income Group

Income Group	Count	PCT of Count
Upper middle income	56	25.80
Lower middle income	47	21.66
High income	80	36.86
Low income	34	15.68

The majority of countries are classified as either high or upper middle income.
Tables 5.2 and 5.3 below replicate tables 3.1 and 3.2 above, with the inclusion of the data's income level. The first table compares the absolute square kilometers of forest area change from 1990 to 2016. The forest area change is shown in descending order.

Table 5.2: Top 5 Decreases in Forest Area by Country Between 1990 and 2016:

Country	Income Group	SQ/KM Forest Area Change
Brazil	Upper middle income	541,510
Indonesia	Lower middle income	282,194
Myanmar	Lower middle income	107,234
Nigeria	Lower middle income	106,506
Tanzania	Lower middle income	102,320

The second table displays countries in descending order of percent forest area change from 1990 to 2016.

Table 5.3: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

Country	Income Group	Pct Forest Area Change
Togo	Low income	75.45
Nigeria	Lower middle income	61.80
Uganda	Low income	59.13
Mauritania	Lower middle income	46.75
Honduras	Lower middle income	45.03

It is worth noting that just one of the ten countries included in these two tables is deemed to be in the higher income category, with zero countries in the High-income group and the rest in the lower income group.

APPENDIX: SQL queries used

Project View

CREATE view forestation as
SELECT f.country_code,f.country_name,f.year,f.forest_area_sqkm,
(f.forest_area_sqkm/2.59) AS forest_area_sqmi,
r.region,r.income_group ,l.total_area_sq_mi,
(l.total_area_sq_mi * 2.59) AS total_area_sqkm,
ROUND((f.forest_area_sqkm/(l.total_area_sq_mi*2.59)*100)::NUMERIC,2) AS percent_forest
FROM regions r
JOIN forest_area f ON r.country_code = f.country_code
JOIN land_area l ON f.country_code = l.country_code
AND f.year = l.year
ORDER BY year ,country_name

PART 1: - GLOBAL SITUATION
a. What was the total forest area (in sq km) of the world in 1990? Please keep in mind that you can use the country record denoted as "World" in the region table.
-> 　　SELECT forest_area_sqkm
　　　　FROM forestation
　　　　WHERE country_name = 'World' AND year = 1990;

b. What was the total forest area (in sq km) of the world in 2016? Please keep in mind that you can use the country record in the table is denoted as "World."
->. 　　SELECT forest_area_sqkm
　　　　FROM forestation
　　　　WHERE country_name = 'World' AND year = 2016;

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?
-> 　　WITH T1 AS
　　　　(SELECT country_name,forest_area_sqkm
　　　　FROM forestation
　　　　WHERE country_name = 'World' AND year = 2016),

```
T2 AS
(SELECT country_name,forest_area_sqkm
FROM forestation
WHERE country_name = 'World' AND year = 1990)

SELECT (T2.forest_area_sqkm-T1.forest_area_sqkm) as difference
FROM T1 JOIN T2
ON T1.country_name=T2.country_name
```
d. What was the percent change in forest area of the world between 1990 and 2016?
```
->      WITH T1 AS
        (SELECT country_name,forest_area_sqkm
        FROM forestation
        WHERE country_name = 'World' AND year = 2016),

        T2 AS
        (SELECT country_name,forest_area_sqkm
        FROM forestation
        WHERE country_name = 'World' AND year = 1990)

        SELECT ((T2.forest_area_sqkm-T1.forest_area_sqkm)/T2.forest_area_sqkm)*100 AS
        difference
        FROM T1 JOIN T2
        ON T1.country_name=T2.country_name
```

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,total_area_sqkm
        FROM forestation
        WHERE year = '2016' AND total_area_sqkm <= 1324449.00
        ORDER BY total_area_sqkm DESC
        LIMIT 1;
```

PART 2 : - REGIONAL OUTLOOK

--Creating table regional forest ----
```
CREATE TABLE regional_forest
 AS
(WITH sqkm_1990 AS
(
SELECT region,
SUM(forest_area_sqkm) AS sum_forest_area_sqkm_1990,
```

SUM(total_area_sqkm) AS sum_land_area_sqkm_1990, ROUND((SUM(forest_area_sqkm) /
SUM(total_area_sqkm))::NUMERIC * 100,2) AS
percentage_forest_area_1990 FROM forestation
WHERE year = 1990
GROUP BY 1),
sqkm_2016 AS (
SELECT region,
SUM(forest_area_sqkm) AS sum_forest_area_sqkm_2016,
SUM(total_area_sqkm) AS sum_land_area_sqkm_2016, ROUND((SUM(forest_area_sqkm) /
SUM(total_area_sqkm))::NUMERIC * 100,2) AS
percentage_forest_area_2016 FROM forestation
WHERE year = 2016
GROUP BY 1)
SELECT sqkm_1990.region,
percentage_forest_area_1990,
percentage_forest_area_2016,
percentage_forest_area_2016 - percentage_forest_area_1990 AS
percentage_forest_area_change
FROM sqkm_1990
INNER JOIN sqkm_2016 ON sqkm_1990.region = sqkm_2016.region -- ORDER BY
sqkm_forest_area_change
ORDER BY percentage_forest_area_1990)

a. What was the percent forest of the entire world in 2016? Which region had the HIGHEST
percent forest in 2016, and which had the LOWEST, to 2 decimal places?
->   SELECT region,percentage_forest_area_2016 FROM regional_forest
        WHERE region = 'World';
->   SELECT region,percentage_forest_area_2016 FROM regional_forest
        order by percentage_forest_area_2016 desc
        limit 1;

b. What was the percent forest of the entire world in 1990? Which region had the HIGHEST
percent forest in 1990, and which had the LOWEST, to 2 decimal places?
->   SELECT region,percentage_forest_area_2016 FROM regional_forest
        order by percentage_forest_area_2016
        limit 1;
->   SELECT region,percentage_forest_area_1990 FROM regional_forest
        order by percentage_forest_area_1990 desc
        limit 1;

c. Based on the table you created, which regions of the world DECREASED in forest area from
1990 to 2016?
->   SELECT region,percentage_forest_area_1990 FROM regional_forest
        order by percentage_forest_area_1990
        limit 1;

->   SELECT region,percentage_forest_area_change FROM regional_forest
        order by percentage_forest_area_change
        limit 1;

Part 3: - Country Level Detail

SUCCESS STORIES

--This query helps in finding the answer to the success stories paragraph

➔ WITH sqkm_1990 AS
(
SELECT country_name, forest_area_sqkm AS forest_area_sqkm_1990 FROM forestation
WHERE year = 1990 AND country_name != 'World'
),

sqkm_2016 AS (
SELECT country_name, forest_area_sqkm AS forest_area_sqkm_2016 FROM forestation
WHERE year = 2016 AND country_name != 'World'
)
SELECT sqkm_1990.country_name,
ROUND((forest_area_sqkm_2016 - forest_area_sqkm_1990)::NUMERIC,2) AS sqkm_change,
ROUND(((forest_area_sqkm_2016 -
forest_area_sqkm_1990)/(forest_area_sqkm_1990))::NUMERIC * 100,2) AS percent_change
FROM sqkm_1990
INNER JOIN sqkm_2016 ON sqkm_1990.country_name = sqkm_2016.country_name WHERE
(forest_area_sqkm_2016 - forest_area_sqkm_1990) is not null
ORDER BY sqkm_change desc;

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 sqkm_1990 AS
(
SELECT country_name,region ,forest_area_sqkm AS forest_area_sqkm_1990 FROM forestation
WHERE year = 1990 AND country_name != 'World'
]),
sqkm_2016 AS (
SELECT country_name,region, forest_area_sqkm AS forest_area_sqkm_2016 FROM forestation
WHERE year = 2016 AND country_name != 'World'
)
SELECT sqkm_1990.country_name,sqkm_1990.region, ROUND((forest_area_sqkm_2016 -
forest_area_sqkm_1990)::NUMERIC,2) AS sqkm_change
FROM sqkm_1990

INNER JOIN sqkm_2016 ON sqkm_1990.country_name = sqkm_2016.country_name ORDER BY
sqkm_change
LIMIT 5;

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 sqkm_1990 AS
(
SELECT country_name, region, forest_area_sqkm AS forest_area_sqkm_1990
FROM forestation
WHERE year = 1990 AND country_name != 'World'),
sqkm_2016 AS (
SELECT country_name, region, forest_area_sqkm AS forest_area_sqkm_2016 FROM forestation
WHERE year = 2016 AND country_name != 'World'
)
SELECT sqkm_1990.country_name, sqkm_1990.region,
ROUND((forest_area_sqkm_2016 - forest_area_sqkm_1990)::NUMERIC,2) AS sqkm_change,
ROUND(((forest_area_sqkm_2016 - forest_area_sqkm_1990)/(forest_area_sqkm_1990))::NUMERIC
* 100,2) AS percent_change FROM sqkm_1990
INNER JOIN sqkm_2016 ON sqkm_1990.country_name = sqkm_2016.country_name WHERE
(forest_area_sqkm_2016 - forest_area_sqkm_1990) is not null
-- ORDER BY sqkm_change
ORDER BY percent_change
LIMIT 5;

c. If countries were grouped by percent forestation in quartiles, which group had the most
countries in it in 2016?

➔ WITH quartile_2016 AS
(
SELECT
case
when percent_forest <= 25.00 then 'Q1'
when percent_forest > 25.00 AND percent_forest <= 50.00 then 'Q2' when percent_forest > 50.00
AND percent_forest <= 75.00 then 'Q3' when percent_forest > 75.00 then 'Q4'
END AS quartile
FROM forestation
WHERE year = 2016 AND country_code != 'WLD' AND percent_forest IS NOT NULL
)
SELECT quartile, count(*) as Number_of_countries FROM quartile_2016
group by 1
order by 1;

d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.
➔ SELECT country_name
FROM forestation
WHERE percent_forest > 75.00 AND year = 2016;

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

➔ SELECT COUNT(*)
FROM forestation a
INNER JOIN forestation b ON a.year = b.year AND a.country_code = b.country_code WHERE a.year =
2016 AND a.percent_forest >
(
SELECT percent_forest
FROM forestation
WHERE year = 2016 AND country_code = 'USA'
)
-> 94

Recommendation: -

WITH tbl_1990 AS
(
SELECT income_group,
COUNT(*) AS COUNT,
ROUND(SUM(forest_area_sqkm)::NUMERIC,2) AS ttl_forest_area,
ROUND(SUM(total_area_sqkm)::NUMERIC,2) AS ttl_land_area, ROUND((SUM(forest_area_sqkm) /
SUM(total_area_sqkm))::NUMERIC * 100, 2) AS
pct_forest
FROM forestation
WHERE year = 1990 AND country_code != 'WLD'
GROUP BY 1),
tbl_2016 AS (
SELECT income_group,
COUNT(*) AS COUNT,
ROUND(SUM(forest_area_sqkm)::NUMERIC,2) AS ttl_forest_area,
ROUND(SUM(total_area_sqkm)::NUMERIC,2) AS ttl_land_area, ROUND((SUM(forest_area_sqkm) /
SUM(total_area_sqkm))::NUMERIC * 100, 2) AS pct_forest
FROM forestation
WHERE year = 2016 AND country_code != 'WLD' GROUP BY 1
)
SELECT tbl_1990.income_group, tbl_2016.COUNT,
tbl_1990.ttl_forest_area AS ttl_forest_area_1990,
tbl_2016.ttl_forest_area AS ttl_forest_area_2016,
tbl_2016.ttl_forest_area - tbl_1990.ttl_forest_area AS ttl_forest_area_change, tbl_1990.pct_forest AS
pct_forest_1990,
tbl_2016.pct_forest AS pct_forest_2016,
tbl_2016.pct_forest - tbl_1990.pct_forest AS pct_change
FROM tbl_1990
INNER JOIN tbl_2016 ON tbl_1990.income_group = tbl_2016.income_group