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 **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 **3.208%**.

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 **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
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 **527229.06**. 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 **79200.00 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	541510.00
Indonesia	East Asia & Pacific	282193.98
Myanmar	East Asia & Pacific	107234.00
Nigeria	Sub-Saharan Africa	106506.00
Tanzania	Sub-Saharan Africa	102320.00

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	-75.75
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
75%-100%	9
50%-75%	38
25%-50%	73
0-25%	85

The largest number of countries in 2016 were found in the **0-25%** 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	98.2576939676578
Micronesia, Fed. Sts.	East Asia & Pacific	91.8572390715248
Gabon	Sub-Saharan Africa	90.0376418700565
Seychelles	Sub-Saharan Africa	88.4111367385789
Palau	East Asia & Pacific	87.6068085491203
American Samoa	East Asia & Pacific	87.5000875000875
Guyana	Latin America & Caribbean	83.9014489110682
Lao PDR	East Asia & Pacific	82.1082317640861
Solomon Islands	East Asia & Pacific	77.8635177945066

94 countries had a percent forestation higher than the United States in 2016.

4. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
- *Which countries should we focus on over others?*

We are losing forests at a loss of 3.208% from 1990 to 2016. The two countries suffered the most decreased forest area percentage was Sub-Saharan Africa and Latin America & Caribbean. Of which the top 4 countries: Togo, Nigeria, Uganda and Mauritania are located in Sub-Saharan Africa. Honduras taking 5th on the list in Latin America.

Sub-Saharan Africa should be our primary focus. Within that region Togo, Nigeria, Uganda and Mauritania are the countries in the top quartiles of forest lost in the analyzed period. With Togo losing over 75%! It has been well known fact that with a fossil fueled economy it has not helped our fight for environmental progress. Also, with production of meat other palm-oil based

consumables. If we can find a safer alternative to gas based machines, and have more plant based consumables we can significantly help our other wise dying planet.

5. Appendix SQL Queries used:

1) Creating the view

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
SELECT f.country_code as f_country_code
, f.country_name as f_country_name
, f.year as f_year
, f.forest_area_sqkm as f_forest_area_sqkm
, 2.59*l.total_area_sq_mi as l_total_area_sqkm
, r.region as r_region
, r.income_group as r_income_group
, (f.forest_area_sqkm * 100)/(total_area_sq_mi * 2.59) as per_forestation
FROM forest_area f
JOIN land_area l
ON f.country_code = l.country_code AND f.year=l.year
JOIN regions r
ON r.country_code=f.country_code
```

2) 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 SUM(f_forest_area_sqkm)
FROM forestation
WHERE f_year = 1990
  AND region = 'World';
```

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 SUM(f_forest_area_sqkm)
FROM forestation
WHERE f_year = 2016
  AND r_region = 'World';
```

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

```
WITH
f_1990 AS (SELECT f_forest_area_sqkm, f_country_name
    FROM forestation
    WHERE f_year = 1990
    AND f_country_name = 'World'),

f_2016 AS (SELECT f_forest_area_sqkm, f_country_name
    FROM forestation
    WHERE f_year = 2016
    AND f_country_name = 'World')

SELECT f_1990.f_forest_area_sqkm - f_2016.f_forest_area_sqkm  AS
forest_area_change
FROM f_1990
JOIN f_2016
ON f_1990.f_country_name = f_2016.f_country_name
```

d. What was the percent change in forest area of the world between 1990 and 2016?

```
SELECT (f_1990.f_forest_area_sqkm - f_2016.f_forest_area_sqkm)*100
/ f_1990.f_forest_area_sqkm AS fa_diff_percentage
FROM f_1990
JOIN f_2016
ON f_1990.f_country_name = f_2016.f_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?

```
WITH
t1 AS (SELECT f_country_name, f_forest_area_sqkm
 FROM forestation
 WHERE f_country_name = 'World' AND f_year = 1990),

t2 AS (SELECT f_country_name, f_forest_area_sqkm
FROM forestation
WHERE f_country_name = 'World' AND f_year = 2016)

SELECT f_country_name, l_total_area_sqkm
FROM forestation
WHERE l_total_area_sqkm BETWEEN 1270000 AND 1350000
```

3) Regional Outlook

```
WITH t1 AS
  (SELECT r_region,
  SUM(f_forest_area_sqkm)*100/SUM(l_total_area_sqkm) AS
f_forest_per_1990 FROM forestation
  WHERE f_year = 1990
    AND r_region NOT LIKE 'World' GROUP BY 1),
  t2 AS
  (SELECT r_region,
  SUM(f_forest_area_sqkm)*100/SUM(l_total_area_sqkm) AS
f_forest_per_2016 FROM forestation
  WHERE f_year = 2016
  AND r_region NOT LIKE 'World' GROUP BY 1)

SELECT t1.r_region, t1.f_forest_per_1990,
t2.f_forest_per_2016
FROM t1
JOIN t2
ON t1.r_region = t2.r_region
ORDER BY 2 DESC;
```

--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?

--Percentage of forest of the entire world in 2016

```
SELECT f_forest_area_sqkm * 100 / l_total_area_sqkm
FROM forestation
WHERE f_year = 2016
AND f_country_name = 'World'; --31.3755709643095
```

-- Region with the HIGHEST percent of forest in 2016 (rounded to 2 decimal place)

```
SELECT r_region,
ROUND(CAST(per_forestation AS numeric), 2)
FROM
(SELECT r_region,
SUM(f_forest_area_sqkm)*100/SUM(l_total_area_sqkm) AS
per_forestation FROM forestation
WHERE f_year = 2016
GROUP BY 1)sub
ORDER BY 2 DESC
```

-- Region with the LOWEST percent of forest in 2016 (rounded to 2 decimal place)

```
SELECT r_region,
ROUND(CAST(per_forestation AS numeric), 2)
FROM
(SELECT r_region,
SUM(f_forest_area_sqkm)*100/SUM(l_total_area_sqkm) AS per_forestation
FROM forestation
WHERE f_year = 2016
GROUP BY 1)sub
ORDER BY 2 LIMIT 1; --Middle East & North Africa 2.07
```

-- 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?

-- Percentage of forest of the entire world in 1990

```
SELECT f_forest_area_sqkm * 100 / l_total_area_sqkm
FROM forestation
WHERE f_year = 1990
AND f_country_name = 'World'; --32.4222035575689
```

-- Region with the HIGHEST percent forest in 1990 (rounded to 2 decimal place)

```
SELECT r_region,
ROUND(CAST(per_forestation AS numeric), 2)
FROM
(SELECT r_region,
SUM(f_forest_area_sqkm)*100/SUM(l_total_area_sqkm) AS per_forestation
FROM forestation
WHERE f_year = 1990
```

-- Region that had the LOWEST percent forest in 1990 (rounded to 2 decimal place)

```
SELECT r_region,
ROUND(CAST(per_forestation AS numeric), 2)
FROM
(SELECT r_region,
SUM(f_forest_area_sqkm)*100/SUM(l_total_area_sqkm) AS per_forestation
FROM forestation
WHERE f_year = 1990
GROUP BY 1)sub
ORDER BY 2 LIMIT 1; --Middle East & North Africa 1.78
```

--c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

```
WITH t1 AS
  (SELECT r_region,
  SUM(f_forest_area_sqkm) AS f_forest_sum_1990 FROM forestation
  WHERE f_year = 1990
    AND r_region NOT LIKE 'World' GROUP BY 1),
  t2 AS
  (SELECT r_region,
  SUM(f_forest_area_sqkm) AS f_forest_sum_2016 FROM forestation
  WHERE f_year = 2016
  AND r_region NOT LIKE 'World' GROUP BY 1)

SELECT t1.r_region, t1.f_forest_sum_1990,
t2.f_forest_sum_2016
FROM t1
JOIN t2
ON t1.r_region = t2.r_region
WHERE t2.f_forest_sum_2016 < t1.f_forest_sum_1990;
```

4) Country-Level Data

--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 r_region
, f_country_name
, f_forest_area_sqkm FROM forestation WHERE f_year = 1990),
t2 AS
(SELECT r_region
, f_country_name
, f_forest_area_sqkm FROM forestation WHERE f_year = 2016)
SELECT t1.r_region
, t1.f_country_name
,t1.f_forest_area_sqkm AS forest_1990
,t2.f_forest_area_sqkm AS forest_2016
, ROUND(CAST((t1.f_forest_area_sqkm - t2.f_forest_area_sqkm) AS numeric), 2) AS difference
FROM t1
JOIN t2
ON t1.f_country_name = t2.f_country_name
WHERE t2.f_forest_area_sqkm < t1.f_forest_area_sqkm
AND t1.r_region NOT LIKE 'World'
ORDER BY difference DESC
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 t1 AS
(SELECT r_region
,f_country_name
,f_forest_area_sqkm FROM forestation WHERE f_year = 1990),
t2 AS
(SELECT r_region
, f_country_name
, f_forest_area_sqkm FROM forestation WHERE f_year = 2016)
SELECT t1.r_region, t1.f_country_name
, t1.f_forest_area_sqkm AS forest_1990
, t2.f_forest_area_sqkm AS forest_2016
, ROUND(CAST((t1.f_forest_area_sqkm - t2.f_forest_area_sqkm) AS numeric), 2) AS difference
, ROUND(CAST(((t1.f_forest_area_sqkm - t2.f_forest_area_sqkm)*100/t1.f_forest_area_sqkm)
AS numeric), 2) AS decrease_percent
FROM t1
JOIN t2
ON t1.f_country_name = t2.f_country_name
WHERE t2.f_forest_area_sqkm < t1.f_forest_area_sqkm
ORDER BY decrease_percent DESC
LIMIT 5;
```

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

```
WITH t1 AS
  (SELECT *
   FROM forestation
   WHERE f_year = 2016
    AND r_region NOT LIKE 'World'
    AND per_forestation IS NOT NULL),
  t2 AS
  (SELECT *,
    CASE
    WHEN per_forestation > 75 THEN 'Fourth'
    WHEN per_forestation <= 75
      AND per_forestation > 50 THEN 'Third'
    WHEN per_forestation <= 50 AND per_forestation >25 THEN
    'Second'
    ELSE 'First'
    END AS quartiles
 FROM t1)
SELECT quartiles,
COUNT(*) AS quartiles_groups
FROM t2
GROUP BY 1;
```

--d. List ALL of the countries that were IN the 4th quartile (percent forest > 75%) IN 2016.

```
SELECT distinct(quartiles)
, COUNT(f_country_name)
OVER (PARTITION BY quartiles)
FROM
(SELECT f_country_name,
  CASE
  WHEN per_forestation <= 25 THEN '0-25%'
  WHEN per_forestation <= 50
   AND per_forestation > 25 THEN '25%-50%'
  WHEN per_forestation <= 75
   AND per_forestation > 50 THEN '50%-75%'
  ELSE '75%-100%'
  END AS quartiles
FROM forestation
WHERE per_forestation IS NOT NULL
  AND f_year=2016) sub;
```

--List of Top Quartile Countries

```
SELECT f_country_name
  , r_region
  , per_forestation
  FROM forestation
  WHERE per_forestation > 75
    AND per_forestation IS NOT NULL
    AND f_year = 2016
  ORDER BY 3 DESC;
```

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

```
  SELECT COUNT(f_country_name)
  FROM forestation
  WHERE f_year = 2016
    AND per_forestation >
  (SELECT per_forestation
  FROM forestation
  WHERE f_country_name = 'United States'
   AND f_year = 2016);
```