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 **41,282,694.9 square km** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9 square km**, a loss of **1,324,449 square 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 **1,279,999.9**).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was **31.74%**. The region with the highest relative forestation was **Latin American & Caribbean**, with **46.7**%, and the region with the lowest relative forestation was **Middle East & North Africa**, with **2.09**% forestation.

In 1990, the percent of the total land area of the world designated as forest was **32.8%**. The region with the highest relative forestation was **Latin American & Caribbean**, with **51.62**%, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.79**% forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016:

Region	**1990 Forest Percentage**	**2016 Forest Percentage**
World	32.8%	31.74%
Latin American & Caribbean	51.62%	46.7%

Middle East & North Africa	1.79%	2.09%

The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Sub-Saharan Africa** (dropped from **31.03**% to **29.12**%) and **Latin American & Caribbean** (**51.62**% to **46.7**%). 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 **32.8**% to **31.74**%.

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 **527,229.06 square 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 square 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 **213.7**% 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 square km
Indonesia	East Asia & Pacific	-282,193.98 square km
Myanmar	East Asia & Pacific	-107,234 square km
Nigeria	Sub-Saharan Africa	-106,506 square km
Tanzania	Sub-Saharan Africa	-102,320 square 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	-61.8%
Uganda	Sub-Saharan Africa	-59.12%
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**
<25% (1st)	85
25-50% (2nd)	73
50-75% (3rd)	38
>75% (4th)	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**
Suriname	Latin America & Caribbean	99.41%
Micronesia, Fed. Sts.	East Asia & Pacific	92.93%
Gabon	Sub-Saharan Africa	91.1%
Seychelles	Sub-Saharan Africa	89.45%
Palau	East Asia & Pacific	88.63%
American Samoa	East Asia & Pacific	88.53%
Guyana	Latin America & Caribbean	84.89%
Lao PDR	East Asia & Pacific	83.07%
Solomon Islands	East Asia & Pacific	78.78%

4. RECOMMENDATIONS

Based on the information presented above, it would be beneficial to focus on countries that significantly increased their forested area to see what policies and actions allowed this to happen. A good example of this, as mentioned above, would be China as they significantly increased their total forested area between the years 1990 and 2016. It would be beneficial to see if there were any policies 1990 and 2016 that aided this increase.

By studying countries that increased forested areas, we can compare them to countries with mass deforestation. Countries in the regions Latin America & Caribbean, Sub-Saharan Africa, and East Asia & Pacific have suffered the most loss by percentage and total land in forestion. We should research if the cause for deforestation in these regions are similar. It would also be helpful to see if the specific countries with mass deforestation have any policies against deforestation in effect right now and, if so, compare those policies to the countries who had increased forestation.

It is also important to note that the countries with the most deforestation come from these three regions, while all 9 of the countries in the top quartile for percentage of land designated as forest also come from these regions. This shows that the most deforestation is happening in regions with the most designated forest land. Perhaps we can look in these regions at the countries that aren't experiencing mass deforestation to see what they are doing differently than countries like Nigeria, Honduras, Indonesia, and Brazil.

4. APPENDIX: SQL Queries

```sql
-- Creating main table
CREATE VIEW forestation AS (
SELECT  f.*,
     l.total_area_sq_mi * 2.56 AS total_area_sqkm,
     100 * forest_area_sqkm/(l.total_area_sq_mi * 2.59) pct_forest_area,
     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);

-- Finding to total forest area in 2016 and 1990
SELECT region, year, SUM(forest_area_sqkm) total_forest_area
FROM forestation
WHERE region = 'World' AND (year = '1990' OR year = '2016')
GROUP BY 1, 2
ORDER BY 2;

-- Subquery to find the difference in forested area between 1990 and 2016
WITH forest_1990 AS (
SELECT SUM(forest_area_sqkm) total_forest_area, year, region
FROM forestation
WHERE region = 'World' AND year = '1990'
GROUP BY 2, 3
ORDER BY 2),

forest_2016 AS (
SELECT SUM(forest_area_sqkm) total_forest_area, year, region
FROM forestation
WHERE region = 'World' AND year = '2016'
GROUP BY 2, 3
ORDER BY 2)
```

```sql
SELECT forest_2016.total_forest_area - forest_1990.total_forest_area AS change_in_sqkm
FROM forest_1990
JOIN forest_2016
ON forest_1990.region = forest_2016.region;

-- Finding the country with closest total land area (in sq km)
WITH forest_1990 AS (
SELECT SUM(forest_area_sqkm) total_forest_area, year, region
FROM forestation
WHERE region = 'World' AND year = '1990'
GROUP BY 2, 3
ORDER BY 2),

forest_2016 AS (
SELECT SUM(forest_area_sqkm) total_forest_area, year, region
FROM forestation
WHERE region = 'World' AND year = '2016'
GROUP BY 2, 3
ORDER BY 2)

SELECT country_code, country_name, year, total_area_sqkm
FROM forestation
WHERE year = '2016' AND total_area_sqkm <= (
   SELECT forest_1990.total_forest_area - forest_2016.total_forest_area AS
change_in_sqkm
   FROM forest_1990
   JOIN forest_2016
   ON forest_1990.region = forest_2016.region)
ORDER BY 4 DESC;

-- Creating regional outlook table
CREATE VIEW regional_outlook AS (
SELECT region, year, 100 * SUM(forest_area_sqkm)/SUM(total_area_sqkm) pct_forest_area
FROM forestation
WHERE year = '1990' OR year = '2016'
GROUP BY 1, 2);
```

```sql
-- Percent forest of entire world in 1990 and 2016
SELECT *
FROM regional_outlook
WHERE region = 'World';

-- Region with highest forest percentage in 2016
SELECT *
FROM regional_outlook
WHERE year = '2016'
ORDER BY 3 DESC;

-- Region with lowest in 2016
SELECT *
FROM regional_outlook
WHERE year = '2016'
ORDER BY 3;

-- Region with highest forest percentage in 1990
SELECT *
FROM regional_outlook
WHERE year = '1990'
ORDER BY 3 DESC;

-- Region with lowest forest percentage in 1990
SELECT *
FROM regional_outlook
WHERE year = '1990'
ORDER BY 3;

-- Regions that decreased in forested areas?
WITH region_1990 AS (
   SELECT *
   FROM regional_outlook
   WHERE year = '1990'
   ORDER BY 3),

region_2016 AS (
   SELECT *
   FROM regional_outlook
```

```
   WHERE year = '2016'
   ORDER BY 3)

SELECT *
FROM region_1990
JOIN region_2016
ON region_1990.region = region_2016.region
WHERE region_1990.pct_forest_area > region_2016.pct_forest_area;

-- Top 5 largest amount decrease in forest area
WITH t1990 AS (
SELECT SUM(forest_area_sqkm) total_forest_area_1990, year, country_name, region
FROM forestation
WHERE year = '1990' AND forest_area_sqkm IS NOT NULL
GROUP BY 2, 3, 4
ORDER BY 1 DESC),

t2016 AS (
SELECT SUM(forest_area_sqkm) total_forest_area_2016, year, country_name, region
FROM forestation
WHERE year = '2016' AND forest_area_sqkm IS NOT NULL
GROUP BY 2, 3, 4
ORDER BY 1 DESC)

SELECT t1990.country_name, t1990.region, t1990.total_forest_area_1990,
t2016.total_forest_area_2016, t2016.total_forest_area_2016 -
t1990.total_forest_area_1990 AS change_in_area
FROM t1990
JOIN t2016
ON t1990.country_name = t2016.country_name
WHERE t1990.country_name != 'World'
ORDER BY 5
LIMIT 5;

-- Top 5 largest percent decrease in forest area
WITH t1990 AS (
SELECT country_name, region, forest_area_sqkm AS total_forest_area_1990
FROM forestation
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL
```

```
GROUP BY 1,2,3),

t2016 AS (
SELECT country_name, region, forest_area_sqkm AS total_forest_area_2016
FROM forestation
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL
GROUP BY 1,2,3)

SELECT t1990.country_name,
   t1990.region,
   t1990.total_forest_area_1990,
   t2016.total_forest_area_2016,
   100*(t2016.total_forest_area_2016 -
t1990.total_forest_area_1990)/t1990.total_forest_area_1990 pct_decrease
FROM t1990
JOIN t2016
ON t2016.country_name = t1990.country_name
WHERE t1990.country_name != 'World'
ORDER BY 5
LIMIT 5;

-- Percentile groupings in 2016
WITH quartiles AS (
 SELECT country_name,
       CASE WHEN pct_forest_area <= 25 THEN '0-25%'
       WHEN pct_forest_area <= 50 THEN '25-50%'
       WHEN pct_forest_area <= 75 THEN '50-75%'
       ELSE '>75%' END AS forestation_quartiles
FROM forestation
WHERE year = 2016 AND pct_forest_area IS NOT NULL
)
SELECT distinct(forestation_quartiles), COUNT(*) OVER (PARTITION BY
forestation_quartiles)
FROM quartiles;

-- List all of the countries that were in the 4th quartile (percent forest > 75%) in
2016.
SELECT country_name, region, SUM(forest_area_sqkm)*100/SUM(total_area_sqkm)
pct_forest_area
```

```sql
FROM forestation
WHERE pct_forest_area > 75 AND year = 2016
GROUP BY 1, 2
ORDER BY 3 DESC;

-- Number of countries with a higher percent forestation than the United States in
2016
SELECT count(*)
FROM forestation
WHERE YEAR = '2016' AND pct_forest_area > (SELECT pct_forest_area
     FROM forestation
     WHERE year = '2016' AND country_name = 'United States');
```