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** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9**, a loss of **1,324,449**, 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 **1,280,000**).

## 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**

### 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**. 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**, 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 **212.50%** from 1990 to 2016.

### 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 (sqkm)** |
| 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 | -75.46 |
| Nigeria | Sub-Saharan Africa | -61.79 |
| Uganda | Sub-Saharan Africa | -59.29 |
| Mauritania | Sub-Saharan Africa | -47.50 |
| 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.

### 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 **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 |

## 4. RECOMMENDATIONS

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

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

|  |  |
| --- | --- |
| **Year** | **Area of annual forest loss in the world** |
| 1991 | -72667 |
| 1992 | -72668 |
| 1993 | -72667 |
| 1994 | -72667 |
| 1995 | -72667 |
| 1996 | -72668 |
| 1997 | -72667 |
| 1998 | -72667 |
| 1999 | -72667 |
| 2000 | -72668 |
| 2001 | -45719 |
| 2002 | -45719 |
| 2003 | -45719 |
| 2004 | -45719 |
| 2005 | -45719 |
| 2006 | -34139 |
| 2007 | -34140 |
| 2008 | -34139 |
| 2009 | -34140 |
| 2010 | -34139 |
| 2011 | -33091 |
| 2012 | -33079 |
| 2013 | -33078 |
| 2014 | -33079 |
| 2015 | -33078 |
| 2016 | -33079 |

*The table above illustrates how much forest area was lost per year between 1990 and 2016. As can be observed, the trend is dropping, which is a good thing, but the situation is far from ideal.*

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

*There should be a global consensus on Latin America & Caribbean region and Sub-Saharan Africa region to stop further deforestation in these areas.*

*That seems there is a big concern about Brazil and Nigeria. Brazil has lost 541,510 square kilometers of its forest between 1990 and 2016, that is a huge number. Nigeria has lost 61% of its forest during the same period that is equivalent 106,506 square kilometers.*

## 5. APPENDIX: SQL Queries Used

**CREATE VIEW :**

Creates a View called “forestation” by joining all three tables - forest\_area, land\_area, and regions.

CREATE VIEW forestation AS

SELECT r.region,

       r.income\_group AS region\_income\_group,

       r.country\_code,

       r.country\_name,

       la.year,

       la.total\_area\_sq\_mi \* 2.59 AS total\_area\_sqkm,

       fa.forest\_area\_sqkm,

       round(((fa.forest\_area\_sqkm \* 100) / (la.total\_area\_sq\_mi \* 2.59))::NUMERIC, 2) AS forest\_percent

FROM  forest\_area fa

JOIN land\_area la ON fa.country\_code=la.country\_code AND fa.year=la.year

JOIN regions r ON fa.country\_code = r.country\_code

ORDER BY 1,3,5;

**Queries of Part 1 :**

-- Finds the total forest area of the world in 1990 1nd 2016, then finds how it changed.

WITH

    world\_1990 AS

    (SELECT f.country\_name, f.forest\_area\_sqkm forest\_area\_1990

     FROM forestation f

     WHERE f.country\_name='World' AND f.year=1990

    ),

    world\_2016 AS

    (SELECT f.country\_name, f.forest\_area\_sqkm forest\_area\_2016

     FROM forestation f

     WHERE f.country\_name='World' AND f.year=2016

    )

SELECT

  y1990.forest\_area\_1990,

  y2016.forest\_area\_2016,

  ROUND((y1990.forest\_area\_1990 - y2016.forest\_area\_2016)::NUMERIC,2) diff\_fa,

  ROUND(((y2016.forest\_area\_2016 - y1990.forest\_area\_1990) / y1990.forest\_area\_1990 \* 100)::NUMERIC,2) diff\_percent

FROM world\_1990 y1990

JOIN world\_2016 y2016 ON y1990.country\_name = y2016.country\_name;

-- Finds the largest country whose total land area is less than the lost forest area between 1990 and 2016.

SELECT f.country\_name, ROUND(f.total\_area\_sqkm)

FROM forestation f

WHERE f.year=2016 AND f.total\_area\_sqkm <= 1324449

ORDER BY f.total\_area\_sqkm DESC

LIMIT 1;

**Queries of Part 2 :**

-- Finds the percent of the total forest area of the world in 1990, 2016.

SELECT f.year, f.forest\_percent

FROM forestation f

WHERE f.country\_name='World' AND f.year in (1990,2016);

-- Finds the percent of the total forest area of each region in 2016.

SELECT f.region,

ROUND(((SUM(f.forest\_area\_sqkm) \* 100)/SUM(f.total\_area\_sqkm))::numeric,2) forest\_percent\_2016

FROM forestation f

WHERE f.year=2016 AND f.region != 'World'

GROUP BY f.region

ORDER BY 1;

-- Finds the percent of the total forest area of each region in 1990.

SELECT f.region,

ROUND(((SUM(f.forest\_area\_sqkm) \* 100)/SUM(f.total\_area\_sqkm))::numeric,2) forest\_percent\_1990

FROM forestation f

WHERE f.year=1990 AND f.region != 'World'

GROUP BY f.region

ORDER BY 1;

**Queries of Part 3 – Section A:**

-- Finds top 2 countries with maximum amount increase in forest area between 1990 and 2016.

SELECT  y1990.country\_name,

        ROUND((y2016.forest\_area\_sqkm -y1990.forest\_area\_sqkm)::NUMERIC)  increased\_amount

FROM forestation y1990

JOIN forestation y2016 ON y1990.country\_code = y2016.country\_code

WHERE y1990.year = 1990

      AND y2016.year = 2016

      AND y1990.forest\_area\_sqkm IS NOT NULL

      AND y2016.forest\_area\_sqkm IS NOT NULL

      AND y1990.country\_name != 'World'

ORDER BY 2 DESC

LIMIT 2;

-- Finds top country with maximum percent increase in forest area between 1990 and 2016.

SELECT  y1990.country\_name,

        ROUND((((y2016.forest\_percent\_2016 - y1990.forest\_percent\_1990)/y1990.forest\_percent\_1990) \* 100)::NUMERIC,2) increased\_percent

FROM

(SELECT f.country\_code, f.country\_name,

        f.forest\_percent forest\_percent\_1990

 FROM forestation f

 WHERE f.year=1990 AND f.forest\_percent IS NOT NULL) y1990

JOIN (SELECT f.country\_code, f.country\_name,

             f.forest\_percent forest\_percent\_2016

      FROM forestation f

      WHERE f.year=2016 AND f.forest\_percent IS NOT NULL) y2016

  ON y1990.country\_code = y2016.country\_code

WHERE y1990.country\_name != 'World' AND y1990.forest\_percent\_1990 != 0

ORDER BY 2 DESC

LIMIT 1;

**Queries of Part 3 – Section B:**

-- Finds top 5 countries with maximum amount decrease in forest area between 1990 and 2016.

WITH

    forestation\_1990 AS

    (SELECT f.country\_code,

            f.country\_name,

            f.region,

            f.forest\_area\_sqkm forest\_area\_1990

     FROM forestation f

     WHERE f.year=1990 AND f.forest\_area\_sqkm IS NOT NULL

    ),

    forestation\_2016 AS

    (SELECT f.country\_code,

            f.country\_name,

            f.region,

            f.forest\_area\_sqkm forest\_area\_2016

    FROM forestation f

    WHERE f.year=2016 AND f.forest\_area\_sqkm IS NOT NULL

    )

SELECT  y1990.country\_name,

        y1990.region,

        ROUND(ABS(y2016.forest\_area\_2016 - y1990.forest\_area\_1990)::NUMERIC)  decreased\_amount

FROM forestation\_1990 y1990

JOIN forestation\_2016 y2016

  ON y1990.country\_code = y2016.country\_code

WHERE y1990.country\_name != 'World'AND y2016.forest\_area\_2016 < y1990.forest\_area\_1990

ORDER BY 3 DESC

LIMIT 5;

-- Finds top 5 countries with maximum percent decrease in forest area between 1990 and 2016.

WITH

    forestation\_1990 AS

    (SELECT f.country\_code,

            f.country\_name,

            f.region,

            f.forest\_percent forest\_percent\_1990

     FROM forestation f

     WHERE f.year=1990 AND f.forest\_percent IS NOT NULL

    ),

    forestation\_2016 AS

    (SELECT f.country\_code,

            f.country\_name,

            f.region,

            f.forest\_percent forest\_percent\_2016

    FROM forestation f

    WHERE f.year=2016 AND f.forest\_percent IS NOT NULL

    )

SELECT  y1990.country\_name,

        y1990.region,

        ROUND(((y2016.forest\_percent\_2016 - y1990.forest\_percent\_1990) / y1990.forest\_percent\_1990 \* 100)::NUMERIC,2) decreased\_percent

FROM forestation\_1990 y1990

JOIN forestation\_2016 y2016

  ON y1990.country\_code = y2016.country\_code

WHERE y1990.country\_name != 'World' AND y1990.forest\_percent\_1990 != 0

ORDER BY 3 ASC

LIMIT 5;

**Queries of Part 3 – Section C:**

-- Counts the countries grouped by forestation percent quartiles in 2016.

WITH quartiles AS

    (SELECT

        f.country\_name,

        f.forest\_percent,

        CASE WHEN f.forest\_percent <= 25 THEN 1

             WHEN f.forest\_percent <= 50 THEN 2

             WHEN f.forest\_percent <= 75 THEN 3

             ELSE 4

        END quartile\_no

    FROM forestation f

    WHERE f.year=2016 AND f.forest\_percent IS NOT NULL

    )

SELECT q.quartile\_no, COUNT(\*) num\_countries

FROM quartiles q

GROUP BY q.quartile\_no

ORDER BY 1;

-- Finds the countries in quartile no. 4 of forestation percent quartiles in 2016.

WITH quartiles AS

    (SELECT

        f.country\_name,

        f.region,

        f.forest\_percent,

        CASE WHEN f.forest\_percent <= 25 THEN 1

             WHEN f.forest\_percent <= 50 THEN 2

             WHEN f.forest\_percent <= 75 THEN 3

             ELSE 4

        END quartile\_no

    FROM forestation f

    WHERE f.year=2016 AND f.forest\_percent IS NOT NULL

    )

SELECT q.country\_name, q.region, q.forest\_percent

FROM quartiles q

WHERE q.quartile\_no = 4

ORDER BY q.forest\_percent DESC;

**Queries of Part 4:**

-- Finds the annually decreased forest area of the world between 1990 and 2016.

SELECT

       sub.year,

       sub.forest\_area - LAG(sub.forest\_area) OVER (ORDER BY sub.year) AS forest\_area\_difference

FROM

( SELECT f.region, f.year,

         ROUND(SUM(f.forest\_area\_sqkm)) AS forest\_area

  FROM forestation f

  WHERE f.region='World'

  GROUP BY f.region, f.year

  ORDER BY 1,2

) sub;