

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.

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1 GLOBAL SITUATION

According to the World Bank, the total forest area of the world was $4.13 \cdot 10^7 \text{ km}^2$ in 1990. As of 2016, the most recent year for which data was available, that number had fallen to $4.00 \cdot 10^7 \text{ km}^2$, a loss of $1.30 \cdot 10^6 \text{ km}^2$, or 3.15 %.

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 $1.28 \cdot 10^6 \text{ km}^2$).

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.

Region	1990 Forest percentage [%]	2016 Forest percentage [%]
East Asia & Pacific	25.77	26.36
Europe & Central Asia	37.27	38.06
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	32.19	27.56

Table 1: Percent Forest Area by Region, 1990 & 2016

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 32.19 % to 27.56 %). 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

3.1 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 $5.27 \cdot 10^5 \text{ km}^2$. 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 $7.92 \cdot 10^4 \text{ km}^2$, 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 1900 to 2016, we aren't surprised to find a much smaller country listed at the top. Iceland increased in forest area by 213.66 %

3.2 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:

Country	Region	Absolute Forest Area Change [km^2]
Brazil	Latin Amreica & Caribbean	$-5.42 \cdot 10^5$
Indonesia	East Asia & Pacific	$-2.82 \cdot 10^5$
Myanmar	East Asia & Pacific	$-1.07 \cdot 10^5$
Nigeria	Sub-Saharan Africa	$-1.07 \cdot 10^5$
Tanzania	Sub-Saharan Africa	$-1.02 \cdot 10^5$

Table 2: Top 5 Amount Decrease in Forest Area by Country, 1990 to 2016

The second way to consider which countries are of concern is to analyze the data by percent decrease.

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

Table 3: Top 5 Percent Decrease in Forest Area by Country, 1990 to 2016

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.

3.3 QUARTILES

Quartile	Number of Countries
0-25	85
25-50	72
50-75	38
75-100	9

Table 4: Count of Countries Grouped by Forestation Percent Quartiles, 2016

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.

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

Table 5: Top Quartile Countries, 2016

4 CONCLUSIONS

Certainly the most important finding of the analysis of the available data is that it is mainly the countries with a large total area that have a global influence on the development of the amount of forests on earth. Extremely high forest shares of sometimes more than 90% look impressive at first glance, but are rather due to geographic peculiarities of the respective country and especially to its very small size. Thus, no insights can be gleaned from these values for moving larger countries toward higher levels of forest cover, nor do they provide any reason to hope that these small countries can be an important pillar in global development.

From a global perspective, it is important for the future to stop the deforestation in countries like Brazil or, in the best case, to reverse it in the long term. We also need to look at how climate change will affect us geographically. It is likely that the equatorial regions will become increasingly warmer and important space for forests will have to give way to prolonged droughts. On the other hand, the "green zones" will move away from the equator toward the poles and occupy land where nothing or at least no forests can currently grow.

Here, countries such as Russia, Greenland or Canada immediately jump to mind, where, on the one hand, there is a lot of open space and, on the other hand, climatic conditions will develop in a much more vegetation-friendly way in the future, even if this is only a small consolation for global climate change.

#####

CODE OVERVIEW FOR MASTERSCHOOL DEFORESTATION PROJECT

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Some introductory remarks:

The queries go in order as they are needed in the report. If a required information no longer appears in the table, it will appear when the next query is called. At one point I calculated two values by hand because it was too simple to write a query for.

#####

JOINED TABLES

WITH

```
base_data AS (  
    SELECT  f.country_code country_code,  
            f.country_name country_name,  
            f.year d_year,  
            f.forest_area_sqkm forest_area_sqkm,  
            l.total_area_sq_mi*2.59 total_area_sqkm,  
            r.region region,  
            r.income_group 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 r.country_code = f.country_code  
    WHERE   forest_area_sqkm IS NOT NULL  
            AND total_area_sq_mi IS NOT NULL  
            AND l.country_code != 'WLD')
```

#####

1. GOLBAL SITUATION

```
SELECT  forest_area_sqkm  
FROM    forest_area f  
WHERE   year = 1990  
        AND country_code = 'WLD'
```

```
SELECT  forest_area_sqkm  
FROM    forest_area f  
WHERE   year = 2016  
        AND country_code = 'WLD'
```

Difference and percentage were calculated manually.

```

WITH
    base_data AS (
        SELECT  f.country_code country_code,
                f.country_name country_name,
                f.year d_year,
                f.forest_area_sqkm forest_area_sqkm,
                l.total_area_sq_mi*2.59 total_area_sqkm,
                r.region region,
                r.income_group 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 r.country_code = f.country_code
        WHERE   forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD')
SELECT  country_name,
        total_area_sqkm
FROM    base_data
WHERE   d_year = 2016
        AND total_area_sqkm < 1300000
ORDER BY 2 DESC
LIMIT 1

```

#####

2. REGIONAL OUTLOOK

```

SELECT  (f.forest_area_sqkm*100/(l.total_area_sq_mi*2.59)) forest_percentage
FROM    forest_area f
JOIN    land_area l ON f.country_code = l.country_code
                AND f.year = l.year
WHERE   f.country_code = 'WLD'
        AND f.year = 2016

```

```

WITH
    base_data AS (
        SELECT  f.country_code country_code,
                f.country_name country_name,
                f.year d_year,
                f.forest_area_sqkm forest_area_sqkm,
                l.total_area_sq_mi*2.59 total_area_sqkm,
                r.region region,
                r.income_group 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 r.country_code = f.country_code
        WHERE   forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD'),

```

```

        region_sums AS (
            SELECT  region,
                    SUM(forest_area_sqkm) forest_sum,
                    SUM(total_area_sqkm) land_sum
            FROM    base_data
            WHERE    d_year = 2016
            GROUP BY 1)
SELECT  region,
        forest_sum*100/land_sum forest_perc
FROM    region_sums
ORDER BY 2 DESC
LIMIT   1

```

```

WITH
    base_data AS (
        SELECT  f.country_code country_code,
                f.country_name country_name,
                f.year d_year,
                f.forest_area_sqkm forest_area_sqkm,
                l.total_area_sq_mi*2.59 total_area_sqkm,
                r.region region,
                r.income_group 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 r.country_code = f.country_code
        WHERE    forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD'),
    region_sums AS (
        SELECT  region,
                SUM(forest_area_sqkm) forest_sum,
                SUM(total_area_sqkm) land_sum
        FROM    base_data
        WHERE    d_year = 2016
        GROUP BY 1)
SELECT  region,
        forest_sum*100/land_sum forest_perc
FROM    region_sums
ORDER BY 2
LIMIT   1

```

```

SELECT  (f.forest_area_sqkm*100/(l.total_area_sq_mi*2.59)) forest_percentage
FROM    forest_area f
JOIN    land_area l ON f.country_code = l.country_code
                AND f.year = l.year
WHERE    f.country_code = 'WLD'
        AND f.year = 1990

```

```

WITH
    base_data AS (
        SELECT  f.country_code country_code,
                f.country_name country_name,
                f.year d_year,
                f.forest_area_sqkm forest_area_sqkm,
                l.total_area_sq_mi*2.59 total_area_sqkm,
                r.region region,
                r.income_group 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 r.country_code = f.country_code
        WHERE   forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD'),
    region_sums AS (
        SELECT  region,
                SUM(forest_area_sqkm) forest_sum,
                SUM(total_area_sqkm) land_sum
        FROM    base_data
        WHERE   d_year = 1990
        GROUP BY 1)
SELECT  region,
        forest_sum*100/land_sum forest_perc
FROM    region_sums
ORDER BY 2 DESC
LIMIT   1

```

```

WITH
    base_data AS (
        SELECT  f.country_code country_code,
                f.country_name country_name,
                f.year d_year,
                f.forest_area_sqkm forest_area_sqkm,
                l.total_area_sq_mi*2.59 total_area_sqkm,
                r.region region,
                r.income_group 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 r.country_code = f.country_code
        WHERE   forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD'),
    region_sums AS (
        SELECT  region,
                SUM(forest_area_sqkm) forest_sum,
                SUM(total_area_sqkm) land_sum
        FROM    base_data
        WHERE   d_year = 1990

```

```

        GROUP BY 1)
SELECT  region,
        forest_sum*100/land_sum forest_perc
FROM    region_sums
ORDER BY 2
LIMIT   1

```

```

WITH
  base_data AS (
    SELECT  f.country_code country_code,
            f.country_name country_name,
            f.year d_year,
            f.forest_area_sqkm forest_area_sqkm,
            l.total_area_sq_mi*2.59 total_area_sqkm,
            r.region region,
            r.income_group 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 r.country_code = f.country_code
    WHERE   forest_area_sqkm IS NOT NULL
            AND total_area_sq_mi IS NOT NULL
            AND l.country_code != 'WLD'),
  region_sums AS (
    SELECT  region,
            d_year,
            SUM(forest_area_sqkm) forest_sum,
            SUM(total_area_sqkm) land_sum
    FROM    base_data
    WHERE   d_year = 1990 OR d_year = 2016
    GROUP BY 1, 2)
SELECT  region,
        d_year,
        forest_sum*100/land_sum forest_perc
FROM    region_sums
ORDER BY 1, 2

```

#####

3. COUNTRY-LEVEL DETAIL

```

WITH
  base_data AS (
    SELECT  f.country_code country_code,
            f.country_name country_name,
            f.year d_year,
            f.forest_area_sqkm forest_area_sqkm,
            l.total_area_sq_mi*2.59 total_area_sqkm,
            r.region region,
            r.income_group 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 r.country_code = f.country_code
WHERE     forest_area_sqkm IS NOT NULL
          AND total_area_sq_mi IS NOT NULL
          AND l.country_code != 'WLD'),
for_area_co_1990 AS (
  SELECT  country_name,
          forest_area_sqkm for_1990
  FROM    base_data
  WHERE   d_year = 1990),
for_area_co_2016 AS (
  SELECT  country_name,
          forest_area_sqkm for_2016
  FROM    base_data
  WHERE   d_year = 2016)
SELECT    f90.country_name country,
          f16.for_2016-f90.for_1990
FROM      for_area_co_1990 f90
JOIN      for_area_co_2016 f16 ON f90.country_name = f16.country_name
ORDER BY 2 DESC
LIMIT     2

```

```

WITH
  base_data AS (
    SELECT  f.country_code country_code,
            f.country_name country_name,
            f.year d_year,
            f.forest_area_sqkm forest_area_sqkm,
            l.total_area_sq_mi*2.59 total_area_sqkm,
            r.region region,
            r.income_group 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 r.country_code = f.country_code
    WHERE   forest_area_sqkm IS NOT NULL
          AND total_area_sq_mi IS NOT NULL
          AND l.country_code != 'WLD'),
  for_area_co_1990 AS (
    SELECT  country_name,
            forest_area_sqkm for_1990
    FROM    base_data
    WHERE   d_year = 1990),
  for_area_co_2016 AS (
    SELECT  country_name,
            forest_area_sqkm for_2016
    FROM    base_data
    WHERE   d_year = 2016)
SELECT    f90.country_name country,
          (f16.for_2016-f90.for_1990)*100/f90.for_1990
FROM      for_area_co_1990 f90
JOIN      for_area_co_2016 f16 ON f90.country_name = f16.country_name

```

```
ORDER BY 2 DESC
LIMIT 1
```

WITH

```
base_data AS (
    SELECT  f.country_code country_code,
            f.country_name country_name,
            f.year d_year,
            f.forest_area_sqkm forest_area_sqkm,
            l.total_area_sq_mi*2.59 total_area_sqkm,
            r.region region,
            r.income_group 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 r.country_code = f.country_code
    WHERE   forest_area_sqkm IS NOT NULL
            AND total_area_sq_mi IS NOT NULL
            AND l.country_code != 'WLD'),
for_area_co_1990 AS (
    SELECT  country_name,
            region,
            forest_area_sqkm for_1990
    FROM    base_data
    WHERE   d_year = 1990),
for_area_co_2016 AS (
    SELECT  country_name,
            forest_area_sqkm for_2016
    FROM    base_data
    WHERE   d_year = 2016)
SELECT  f90.country_name country,
        f90.region,
        f16.for_2016-f90.for_1990
FROM    for_area_co_1990 f90
JOIN    for_area_co_2016 f16 ON f90.country_name = f16.country_name
ORDER BY 3
LIMIT 5
```

WITH

```
base_data AS (
    SELECT  f.country_code country_code,
            f.country_name country_name,
            f.year d_year,
            f.forest_area_sqkm forest_area_sqkm,
            l.total_area_sq_mi*2.59 total_area_sqkm,
            r.region region,
            r.income_group 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 r.country_code = f.country_code
        WHERE     forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD'),
for_area_co_1990 AS (
    SELECT      country_name,
               region,
               forest_area_sqkm for_1990
    FROM        base_data
    WHERE       d_year = 1990),
for_area_co_2016 AS (
    SELECT      country_name,
               forest_area_sqkm for_2016
    FROM        base_data
    WHERE       d_year = 2016)
SELECT  f90.country_name country,
        f90.region,
        (f16.for_2016-f90.for_1990)*100/f90.for_1990
FROM    for_area_co_1990 f90
JOIN    for_area_co_2016 f16 ON f90.country_name = f16.country_name
ORDER BY 3
LIMIT 5

```

```

WITH
    base_data AS (
        SELECT  f.country_code country_code,
                f.country_name country_name,
                f.year d_year,
                f.forest_area_sqkm forest_area_sqkm,
                l.total_area_sq_mi*2.59 total_area_sqkm,
                r.region region,
                r.income_group 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 r.country_code = f.country_code
        WHERE   forest_area_sqkm IS NOT NULL
                AND total_area_sq_mi IS NOT NULL
                AND l.country_code != 'WLD'),
    percents_16 AS (
        SELECT  country_code,
                CASE
                    WHEN forest_area_sqkm*100/total_area_sqkm < 25 THEN '0-25'
                    WHEN forest_area_sqkm*100/total_area_sqkm < 50 THEN '25-50'
                    WHEN forest_area_sqkm*100/total_area_sqkm < 75 THEN '50-75'
                    ELSE '75-100'
                END quartile
        FROM    base_data
        WHERE   d_year = 2016)
SELECT  quartile,
        COUNT(country_code)
FROM    percents_16

```



```
GROUP BY 1
ORDER BY 1
```

```
WITH
  base_data AS (
    SELECT  f.country_code country_code,
            f.country_name country_name,
            f.year d_year,
            f.forest_area_sqkm forest_area_sqkm,
            l.total_area_sq_mi*2.59 total_area_sqkm,
            r.region region,
            r.income_group 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 r.country_code = f.country_code
    WHERE   forest_area_sqkm IS NOT NULL
            AND total_area_sq_mi IS NOT NULL
            AND l.country_code != 'WLD')
SELECT  country_name,
        region,
        forest_area_sqkm*100/total_area_sqkm percentage
FROM    base_data
WHERE   d_year = 2016
        AND forest_area_sqkm*100/total_area_sqkm >= 75
ORDER BY 3 DESC
```