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 km2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to39958245.9 km2, a loss of 1324449 km2, or 3.21%.

The forest area lost over this time period is slightly more than the entire land area of Mongolia listed for the year 2016 (which is 1553560 km2).

## 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 |
| 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 Sub-Saharan Africa (dropped from 30.67% to 28.79%) and Latin America & Caribbean (51.03% to 46.16%). 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 527229.06 km2. 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 km2, much lower than the figure for China.

China and 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 313.66% 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 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 | Absolute Forest Area Change [km2] |
| Brazil | Latin America & Caribbean | -541510 |
| Indonesia | East Asia & Pacific | -282194 |
| Myanmar | East Asia & Pacific | -107234 |
| Nigeria | Sub-Saharan Africa | -106506 |
| Tanzania | Sub-Saharan Africa | -102320 |

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 | -59.13 |
| 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.

### QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

|  |  |
| --- | --- |
| Quartile | Number of Countries |
| First | 85 |
| Second | 73 |
| Third | 38 |
| Fourth | 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?*
* *Which countries should we focus on over others?*

Based on analysis from the World Bank, there are signs of further shrinkage of global forest area. Most attention should be focused on countries where there has been the greatest percentage reduction in forest area. Those countries are Togo, Nigeria, Uganda, Mauritania and Honduras. Four out of five those countries are located in the Sub-Saharan Africa region and all have low to lower middle income. It is important to assess the reasons for the decline in forest cover in these regions. Whether this is due to sourcing of exotic wood, agriculture, fires or climate changes. A good example of a country that has increased its forest area is China. This case should be studied and recommendations made for low income countries.

## 5. APPENDIX: SQL queries used

-- Create a View by joining all three tables - forest\_area, land\_area and regions

CREATE VIEW forestation AS

SELECT fa.country\_code,

  fa.country\_name,

  r.region,

  r.income\_group,

  fa.year,

  fa.forest\_area\_sqkm,

  -- convert land area to square kilimeters

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

  -- compute the percent of forest area

  (

    fa.forest\_area\_sqkm / (la.total\_area\_sq\_mi \* 2.59)

  ) \* 100 AS forest\_percent

FROM forest\_area AS fa -- join land and forest tables

  JOIN land\_area AS la ON fa.country\_code = la.country\_code

  AND fa.year = la.year -- join region to forest table

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

ORDER BY country\_code,

  year;

-- PART 1

-- GLOBAL SITUATION

-- Q1

/\* 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 ROUND(forest\_area\_sqkm) AS forest\_area\_sqkm\_1990

FROM forestation

WHERE year = 1990 AND country\_name = 'World';

-- Q2

/\* 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 ROUND(forest\_area\_sqkm) AS forest\_area\_sqkm\_2016

FROM forestation

WHERE year = 2016 AND country\_name = 'World';

-- Q3

/\* What was the change (in sq km) in the forest area of the world from 1990 to 2016? \*/

WITH table1 AS(

  SELECT forest\_area\_sqkm AS forest\_area\_sqkm\_1990

  FROM forestation

  WHERE year = 1990

    AND country\_name = 'World'

),

table2 AS(

  SELECT forest\_area\_sqkm AS forest\_area\_sqkm\_2016

  FROM forestation

  WHERE year = 2016

    AND country\_name = 'World'

)

SELECT ROUND(table1.forest\_area\_sqkm\_1990 - table2.forest\_area\_sqkm\_2016) AS forest\_area\_change

FROM table1,

  table2;

-- Q4

/\* What was the percent change in forest area of the world between 1990 and 2016? \*/

WITH table1 AS(

  SELECT forest\_area\_sqkm AS forest\_area\_sqkm\_1990

  FROM forestation

  WHERE year = 1990

    AND country\_name = 'World'

),

table2 AS(

  SELECT forest\_area\_sqkm AS forest\_area\_sqkm\_2016

  FROM forestation

  WHERE year = 2016

    AND country\_name = 'World'

)

SELECT ROUND(

    (

      (

        -(

          table1.forest\_area\_sqkm\_1990 - table2.forest\_area\_sqkm\_2016

        ) / table1.forest\_area\_sqkm\_1990

      ) \* 100

    )::NUMERIC,

    2

  )::VARCHAR || '%' AS forest\_area\_change

FROM table1,

  table2;

-- Q5

/\* 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 DISTINCT country\_name,

  ROUND(total\_area\_sqkm::NUMERIC) AS total\_area\_sqkm

FROM forestation

WHERE total\_area\_sqkm >= (

    WITH table1 AS(

      SELECT forest\_area\_sqkm AS forest\_area\_sqkm\_1990

      FROM forestation

      WHERE year = 1990

        AND country\_name = 'World'

    ),

    table2 AS(

      SELECT forest\_area\_sqkm AS forest\_area\_sqkm\_2016

      FROM forestation

      WHERE year = 2016

        AND country\_name = 'World'

    )

    SELECT table1.forest\_area\_sqkm\_1990 - table2.forest\_area\_sqkm\_2016 AS forest\_area\_change

    FROM table1,

      table2

  )

ORDER BY total\_area\_sqkm

LIMIT 1;

-- PART 2

-- REGIONAL OUTLOOK

-- Q1

/\* 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 sub.\*,

  ROUND(

    ((sub.forest\_area / sub.land\_area) \* 100)::NUMERIC,

    2

  ) AS forest\_percent

FROM(SELECT region,

      SUM(forest\_area\_sqkm) AS forest\_area,

      SUM(total\_area\_sqkm) AS land\_area

    FROM forestation

    GROUP BY region,

      year

    HAVING year = 2016) AS sub

ORDER BY region;

-- Q2

/\* 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 sub.\*,

  ROUND(

    ((sub.forest\_area / sub.land\_area) \* 100)::NUMERIC,

    2

  ) AS forest\_percent

FROM(

    SELECT region,

      SUM(forest\_area\_sqkm) AS forest\_area,

      SUM(total\_area\_sqkm) AS land\_area

    FROM forestation

    GROUP BY region,

      year

    HAVING year = 1990

  ) AS sub

ORDER BY region;

-- Q3

/\* Based on the table you created,

 which regions of the world DECREASED in forest area from 1990 to 2016? \*/

WITH t1 AS (

  SELECT sub.\*,

    ROUND(

      ((sub.forest\_area / sub.land\_area) \* 100)::NUMERIC,

      2

    ) AS forest\_percent

  FROM(

      SELECT region,

        SUM(forest\_area\_sqkm) AS forest\_area,

        SUM(total\_area\_sqkm) AS land\_area

      FROM forestation

      GROUP BY region,

        year

      HAVING year = 2016

    ) AS sub

  ORDER BY forest\_percent

),

t2 AS (

  SELECT sub.\*,

    ROUND(

      ((sub.forest\_area / sub.land\_area) \* 100)::NUMERIC,

      2

    ) AS forest\_percent

  FROM(

      SELECT region,

        SUM(forest\_area\_sqkm) AS forest\_area,

        SUM(total\_area\_sqkm) AS land\_area

      FROM forestation

      GROUP BY region,

        year

      HAVING year = 1990

    ) AS sub

  ORDER BY forest\_percent

)

SELECT t1.region,

  t1.forest\_percent - t2.forest\_percent AS change\_prc

FROM t1

  JOIN t2 ON t1.region = t2.region

  AND t1.forest\_percent < t2.forest\_percent

ORDER BY change\_prc;

-- PART 3

-- COUNTRY-LEVEL DETAIL

-- Q1

/\* 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 country\_code,

    country\_name,

    region,

    forest\_area\_sqkm

  FROM forestation

  WHERE year = 1990

),

t2 AS (

  SELECT country\_code,

    country\_name,

    forest\_area\_sqkm

  FROM forestation

  WHERE year = 2016

)

SELECT t1.country\_name,

  t1.region,

  t1.forest\_area\_sqkm AS forest\_area\_1990,

  t2.forest\_area\_sqkm AS forest\_area\_2016,

  ROUND(

    (t2.forest\_area\_sqkm - t1.forest\_area\_sqkm)::NUMERIC,

    2

  ) AS change

FROM t1

  JOIN t2 ON t1.country\_code = t2.country\_code

WHERE t1.country\_name NOT LIKE 'World'

ORDER BY change

LIMIT 5;

-- Q2

/\* 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 country\_code,

    country\_name,

    region,

    forest\_area\_sqkm

  FROM forestation

  WHERE year = 1990

),

t2 AS (

  SELECT country\_code,

    country\_name,

    forest\_area\_sqkm

  FROM forestation

  WHERE year = 2016

)

SELECT t1.country\_name,

  t1.region,

  t1.forest\_area\_sqkm AS forest\_area\_1990,

  t2.forest\_area\_sqkm AS forest\_area\_2016,

  ROUND(

    -((1 -(t2.forest\_area\_sqkm / t1.forest\_area\_sqkm)) \* 100)::NUMERIC, 2) AS change\_prc

FROM t1

  JOIN t2 ON t1.country\_code = t2.country\_code

  AND t2.forest\_area\_sqkm < t1.forest\_area\_sqkm

WHERE t1.country\_name NOT LIKE 'World'

ORDER BY change\_prc

LIMIT 5;

-- Q3

/\* If countries were grouped by percent forestation in quartiles,

 which group had the most countries in it in 2016? \*/

WITH sub AS (

  SELECT country\_name,

    CASE

      WHEN forest\_percent < 25 THEN '0-25%'

      WHEN forest\_percent >= 25

      AND forest\_percent < 50 THEN '25-50%'

      WHEN forest\_percent >= 50

      AND forest\_percent < 75 THEN '50-75%'

      ELSE '75-100%'

    END AS quartile

  FROM forestation

  WHERE year = 2016

    AND forest\_percent IS NOT NULL

)

SELECT DISTINCT quartile,

  (COUNT(country\_name) OVER (PARTITION BY quartile)) AS count

FROM sub

ORDER BY quartile;

-- Q4

/\* List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016. \*/

WITH sub AS (

  SELECT country\_name,

    CASE

      WHEN forest\_percent < 25 THEN '0-25%'

      WHEN forest\_percent >= 25

      AND forest\_percent < 50 THEN '25-50%'

      WHEN forest\_percent >= 50

      AND forest\_percent < 75 THEN '50-75%'

      ELSE '75-100%'

    END AS quartile

  FROM forestation

  WHERE year = 2016

    AND forest\_percent IS NOT NULL

)

SELECT country\_name,

  quartile

FROM sub

WHERE quartile = '75-100%';

-- Q5

/\* How many countries had a percent forestation higher than the United States in 2016? \*/

SELECT COUNT(\*) AS count

FROM(

    SELECT DISTINCT country\_name

    FROM forestation

    WHERE forest\_percent > (

        SELECT forest\_percent

        FROM forestation

        WHERE (country\_name = 'United States')

          AND year = 2016

      )

    ORDER BY country\_name

  ) AS sub;