

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 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 3.2 %.

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 1279999.9891).

2. REGIONAL OUTLOOK

In 2016, the percentage of the total land area of the world designated as forest was 31.3 . 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 32.4. 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 527229.062. 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, 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. Island increased its 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
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	61.80
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 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
1	98
2	72
3	38
4	9

The largest number of countries in 2016 were found in the First quartile.

There were 98 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 percent forestation higher than the United States in 2016

5. RECOMMENDATIONS

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

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

Based on analyses we can tell that the total forest area in the world is slowly decreasing. The biggest decrease between 1990 and 2016 was found in the Sub-Saharan African region. Top 3 countries with the biggest forest percentage decrease are Togo (75.45%), Nigeria(61.80%), Uganda(59.13%).

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

Beside countries with the highest percentage of forest decreasing we also have to focus on Latin America & Caribbean region where forest percentage decreased from 51.03 to 46.16 in 16 years. By looking at absolute forest area change Brazil is at the top of the list with a drop of 541510 square kilometers.

Recommendation would be to create a world organization that would control deforestation by the regions and countries.

APPENDIX : SQL Queries used for this project.

```
CREATE VIEW forestation AS
```

```
  SELECT
```

```
    f.country_code
```

```
    ,f.country_name
```

```
    ,f.year
```

```
    ,r.region
```

```
    ,r.income_group
```

```
    ,l.total_area_sq_mi*2.59 total_area_sqkm
```

```
    ,f.forest_area_sqkm
```

```
    ,(f.forest_area_sqkm*100)/(l.total_area_sq_mi*2.59) forest_pct
```

```
  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 = l.country_code
```

1. 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(forest_area_sqkm) total_forest_area
FROM forestation
WHERE 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(forest_area_sqkm) total_forest_area
FROM forestation
WHERE year = 2016 AND region = 'World'
```

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

```
WITH T1 AS
    (SELECT
        SUM(forest_area_sqkm) total_forest_area_2016
    FROM forestation
    WHERE year = 1990 AND region = 'World')
SELECT
    T1.total_forest_area_2016-
    (SELECT
        SUM(forest_area_sqkm) total_forest_area_2016
    FROM forestation
    WHERE year = 2016 AND region = 'World') AS total_change
FROM T1
```

```

-----USING----SELF JOIN-----
SELECT
    (f1.forest_area_sqkm-f2.forest_area_sqkm) forest_change_sqkm
FROM forestation f1, forestation f2
WHERE f1.year = 1990
    AND f1.region = 'World'
    AND f2.year = 2016
    AND f2.region = 'World'

```

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

```

WITH T1 AS
    (SELECT
        SUM(forest_area_sqkm) total_forest_area_2016
        FROM forestation
        WHERE year = 1990 AND region = 'World')
SELECT
    100*(T1.total_forest_area_2016-
    (SELECT
        SUM(forest_area_sqkm) total_forest_area_2016
        FROM forestation
        WHERE year = 2016 AND region ='World'))
    /T1.total_forest_area_2016 AS pct_change
FROM T1

```

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?

```

SELECT
    country_name
    ,total_area_sqkm
    ,abs(total_area_sqkm-1324449)
    ,ROW_NUMBER() OVER(ORDER BY abs(total_area_sqkm-1324449)) rw
FROM forestation
WHERE year = 2016
LIMIT 1

```

2. REGIONAL OUTLOOK

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?

```
SELECT
    forest_area_sqkm*100/total_area_sqkm forest_pct_2016
FROM forestation
WHERE year = 2016 AND country_name = 'World'
```

```
SELECT
    region
    ,ROUND(CAST(pct_forest_2016 AS NUMERIC),2)
FROM
    (SELECT
        region
        ,year
        ,SUM(forest_area_sqkm*100)/SUM(total_area_sqkm) pct_forest_2016
    FROM forestation
    WHERE year = 2016
    GROUP BY 1,2
    ORDER BY 3 DESC
    LIMIT 1) sub
```

```
SELECT
    region
    ,ROUND(CAST(pct_forest_2016 AS NUMERIC),2)
FROM
    (SELECT
        region
        ,year
        ,SUM(forest_area_sqkm*100)/SUM(total_area_sqkm) pct_forest_2016
    FROM forestation
    WHERE year = 2016
    GROUP BY 1,2
```


ORDER BY 3

LIMIT 1) sub

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?

SELECT

forest_area_sqkm*100/total_area_sqkm forest_pct_1190

FROM forestation

WHERE year = 1990 AND country_name = 'World'

SELECT

region

,ROUND(CAST(pct_forest_1990 AS NUMERIC),2)

FROM

(SELECT

region

,year

,SUM(forest_area_sqkm*100)/SUM(total_area_sqkm) pct_forest_2016

FROM forestation

WHERE year = 1990

GROUP BY 1,2

ORDER BY 3 DESC

LIMIT 1) sub

SELECT

region

,ROUND(CAST(pct_forest_1990 AS NUMERIC),2)

FROM

(SELECT

region

,year

,SUM(forest_area_sqkm*100)/SUM(total_area_sqkm) pct_forest_1990

FROM forestation

WHERE year = 1990

GROUP BY 1,2

```
ORDER BY 3
LIMIT 1) sub
```

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

```
WITH T1 AS
  (SELECT
    region
    ,SUM(forest_area_sqkm) forest_total_1990
  FROM forestation
  WHERE year = 1990 AND NOT region = 'World'
  GROUP BY 1),
T2 AS
  (SELECT
    region
    ,SUM(forest_area_sqkm) forest_total_2016
  FROM forestation
  WHERE year = 2016 AND NOT region = 'World'
  GROUP BY 1)
SELECT
  T1.region
  ,T1.forest_total_1990
  ,T2.forest_total_2016
  ,abs(T2.forest_total_2016 - T1.forest_total_1990) diff
FROM T1
JOIN T2 ON T1.region=T2.region
AND T2.forest_total_2016 < T1.forest_total_1990
ORDER BY diff DESC
```

3. COUNTRY-LEVEL DETAIL

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. *Island* increased its forest area by 213.66% from 1990 to 2016.

Dear Reviewer, please find results for the statement above (Island and 213.66%) using the query below.

```

WITH T1 AS
  (SELECT
    region
    ,country_name
    ,forest_area_sqkm
  FROM forestation
  WHERE year = 1990),

T2 AS
  (SELECT
    region
    ,country_name
    ,forest_area_sqkm
  FROM forestation
  WHERE year = 2016)
SELECT
  T1.region
  ,T1.country_name
  ,T1.forest_area_sqkm forest_1990
  ,T2.forest_area_sqkm forest_2016
  ,abs(ROUND(T1.forest_area_sqkm - T2.forest_area_sqkm)) AS diff
  ,abs(ROUND(CAST((T2.forest_area_sqkm-T1.forest_area_sqkm)/T1.forest_area_sqkm*100
AS
  NUMERIC), 2)) AS pct_forest
FROM T1 JOIN T2 ON T1.country_name = T2.country_name
WHERE T2.forest_area_sqkm>T1.forest_area_sqkm
      AND T1.region NOT LIKE 'World'
ORDER BY 6 DESC
LIMIT 1

```

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
    region
    ,country_name
    ,forest_area_sqkm
  FROM forestation
  WHERE year = 1990),

```

T2 AS

```
(SELECT
    region
    ,country_name
    ,forest_area_sqkm
FROM forestation
WHERE year = 2016)
```

SELECT

```
    T1.region
    ,T1.country_name
    ,T1.forest_area_sqkm forest_1990
    ,T2.forest_area_sqkm forest_2016
    ,ROUND(T1.forest_area_sqkm - T2.forest_area_sqkm) AS diff
    ,abs(ROUND(CAST((T2.forest_area_sqkm-T1.forest_area_sqkm)/T1.forest_area_sqkm*100 AS
        NUMERIC), 2)) AS pct_forest
FROM T1 JOIN T2 ON T1.country_name = T2.country_name
WHERE T2.forest_area_sqkm<T1.forest_area_sqkm
    AND T1.region NOT LIKE 'World'
ORDER BY 5 DESC
```

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
    region
    ,country_name
    ,forest_area_sqkm
FROM forestation
WHERE year = 1990),
```

T2 AS

```
(SELECT
    region
```

```
,country_name
,forest_area_sqkm
FROM forestation
WHERE year = 2016)
```

```
SELECT
    T1.region
    ,T1.country_name
    ,T1.forest_area_sqkm forest_1990
    ,T2.forest_area_sqkm forest_2016
    ,ROUND(T1.forest_area_sqkm - T2.forest_area_sqkm) AS diff
    ,abs(ROUND(CAST((T2.forest_area_sqkm-T1.forest_area_sqkm)/T1.forest_area_sqkm*100 AS
                    NUMERIC), 2)) AS pct_forest
FROM T1 JOIN T2 ON T1.country_name = T2.country_name
WHERE T2.forest_area_sqkm<T1.forest_area_sqkm
      AND T1.region NOT LIKE 'World'
ORDER BY 6 DESC
```

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 year = 2016
      AND region NOT LIKE 'World'),
T2 AS
    (SELECT *,
    CASE
    WHEN forest_pct >75 THEN '4'
    WHEN forest_pct <=75
    AND forest_pct>50 THEN '3'
    WHEN forest_pct <=50
    AND forest_pct >25 THEN '2'
    ELSE '1' END AS quartiles
    FROM T1)
SELECT quartiles,
```

```
        COUNT(*) groups
FROM T2
GROUP BY 1
ORDER BY 1
```

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

```
SELECT
    country_name
    ,region
    ,forest_pct
FROM forestation
WHERE forest_pct > 75 AND year =2016
ORDER BY forest_pct DESC
```

e. How many countries had a percent forestation higher than the United States in 2016?
WITH T1 AS

```
WITH T1 AS
(
    SELECT
        country_name
        ,region
        ,forest_pct
    FROM forestation
    WHERE forest_pct >
        (
            SELECT forest_pct
            FROM forestation
            WHERE country_name = 'United States'
            AND year =2016)
    AND year = 2016)
SELECT
    COUNT(*)
FROM T1
```