

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 to 39958245.9 km², a loss of 1324449 km², or 3.31 %.

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 1279999.99 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	forest_percentage_1990	forest_percentage_2016
Latin America & Caribbean	51.03	46.16
Sub-Saharan Africa	30.67	28.79
Europe & Central Asia	37.28	38.04
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.51
Middle East & North Africa	1.78	2.07
World	32.42	31.38
North America	35.65	36.04

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 [527229.06 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 [79200km²](#), 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 [213.66 %](#) 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_km
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	forest_area_change_percent
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.

C. QUARTILES

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

quartile	count
0-25%	85
25% -50%	73
50% - 75%	38
75% - 100%	9

The largest number of countries in 2016 were found in the 1 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	87.5
Guyana	Latin America & Caribbean	83.9
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

Table 3.5: Countries Distribution by income grouped by Forestation Percent Quartiles, 1990:

land_as_forest_in_percent	amount_of_countries	income_group
0-25%	30	High income
25% -50%	25	High income
50% - 75%	11	High income
75% - 100%	2	High income
0-25%	21	Lower middle income
25% -50%	9	Lower middle income
50% - 75%	12	Lower middle income
75% - 100%	2	Lower middle income
0-25%	15	Low income
25% -50%	9	Low income
50% - 75%	7	Low income
75% - 100%	1	Low income
0-25%	20	Upper middle income
25% -50%	17	Upper middle income
50% - 75%	13	Upper middle income
75% - 100%	4	Upper middle income

Table 3.6: Countries Distribution by income grouped by Forestation Percent Quartiles, 2016:

land_as_forest_in_percent	amount_of_countries	income_group
0-25%	29	High income
25% -50%	27	High income
50% - 75%	13	High income
75% - 100%	2	High income
0-25%	20	Lower middle income
25% -50%	15	Lower middle income
50% - 75%	7	Lower middle income
75% - 100%	3	Lower middle income
0-25%	18	Low income
25% -50%	12	Low income
50% - 75%	3	Low income
0-25%	18	Upper middle income
25% -50%	18	Upper middle income
50% - 75%	15	Upper middle income
75% - 100%	4	Upper middle income

5. RECOMMENDATIONS

The report used the data for the time period from 1990 to 2016. It looked at the scope and impact of deforestation in two different ways. One is in absolute numbers: total area of forest cleared over the period and another way is in terms of the percent of the forest that was cleared over the time period. The report provides information at three different levels: global impact, by region and by country. The information about some countries was unavailable or incomplete so it was omitted.

Globally, the loss of the forest area was 3.31% over 26 years. The situation does not look gruesome unless it is visualized. The size of the lost forest area in absolute numbers is equal to entire Peru size. Peru is slightly smaller than Alaska. The world will lose another Alaska in the next 26 years if deforestation speed will stay at the same level.

Regionally, the situation doesn't look so grim. There are only two regions that decreased in percent forest area: Latin America & Caribbean and Sub-Saharan Africa. Unfortunately, these two regions heavily affect the global figures. To understand the reasons of the forest loss I would recommend to investigate the situation in these regions in more details to find the direct causes of the deforestation (agricultural expansion, wood extraction or infrastructure expansion.)

It was possible to forecast that countries from Latin America & Caribbean and Sub-Saharan Africa regions will be in the top 5 list of the forest loss. Four countries in the top 5 list by percentage loss (Togo, Nigeria, Uganda and Mauritania) and 2 countries (Nigeria, Tanzania) in the top 5 list in absolute numbers are from Sub-Saharan Africa region. Nigeria, Sub-Saharan Africa, is in the both lists.

Two different countries from Latin America & Caribbean region in the top 5 lists: Honduras by percentage and Brazil in absolute numbers. Brazil is the fifth largest country in the world and its territory is larger than the continental United States so inevitably even a small percentage of loss will lead to significant amount in absolute numbers. Notably, Honduras is about 76 times smaller than Brazil.

Interestingly, there are two different countries from East Asia & Pacific region in the top 5 of the forest loss in absolute numbers: Indonesia and Myanmar. Indonesia is the world's largest island country and the 14th largest country by land, and it's 8 times bigger than United Kingdom. Myanmar (Burma) is the largest country in Mainland Southeast Asia and is approximately Turkey size.

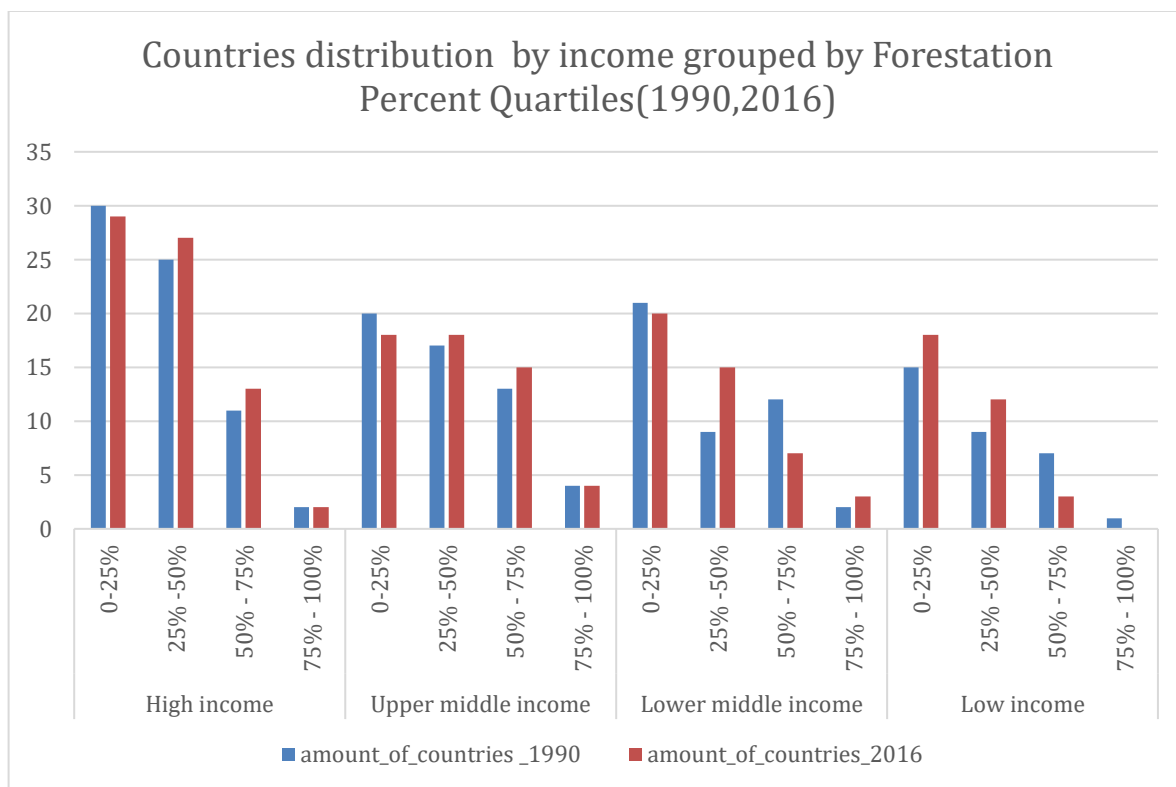
I would recommend to investigate the situation in the countries listed above in more details to find the direct causes of the deforestation.

On the contrary, Iceland is 0.92 times as big as Honduras, it increased in forest area by 213.66 % over the period. China and United States, the biggest countries in the world after Russia and Canada) are ahead in absolute numbers.

I would suggest to analyse the Iceland situation and find out the roots of the Iceland success.

It can be noted that there is no low income countries with forestation over 75% in 2016 if we look at the countries distribution by income grouped by Forestation Percent Quartiles. The certain dynamic is seen in the 0-25% Quartile. On the bright side, the amount of countries with forestation below 25% was 30 with high, 20 with upper middle and 21 with lower middle income

in 1990. In 2016, the amount of countries with forestation below 25% was 29 with high, 18 with upper middle and 20 with lower middle income. There is opposite dynamic for the countries with low income, from 15 to 18. There is similar dynamic in other quartiles.



APPENDIX: SQL queries used

The following VIEW was created and utilised to prepare the report:

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
SELECT
    f.country_code, f.country_name, r.region, r.income_group, f.year, l.total_area_sq_mi,
    ROUND((l.total_area_sq_mi*2.59):: numeric,2)
    total_area_sq_km, f.forest_area_sqkm,
    ROUND((f.forest_area_sqkm/(l.total_area_sq_mi*2.59)*100)::numeric,2)
    land_as_forest_km_percent
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
WHERE f.forest_area_sqkm IS NOT NULL AND l.total_area_sq_mi IS NOT NULL;
```

The countries where information about total land area and forest designated area were not available were omitted.

1. GLOBAL SITUATION

The total forest area of the world in 1990, The total forest area of the world in 2016, the difference in km² and %.

```
WITH info_1990_and_2016
AS
    (SELECT country_name, year, forest_area_sqkm
    FROM forestation
    WHERE region='World' AND year=1990 OR region='World' AND year=2016
    )
SELECT
    country_name, year, forest_area_sqkm,
    LAG(forest_area_sqkm) OVER (ORDER BY year) AS lag,
    LAG(forest_area_sqkm) OVER (ORDER BY year) - forest_area_sqkm as change_1990_2016,
    ROUND((((LAG(forest_area_sqkm) OVER (ORDER BY year) -
    forest_area_sqkm)/forest_area_sqkm)*100) ::numeric,2) change_1990_2016_percent

FROM info_1990_and_2016
```

Country which total area in 2016 closest to the loss of the forest area lost over the period

```
WITH info_countries_2016
AS
    (SELECT country_name, total_area_sq_km
    FROM forestation
    WHERE year=2016
    )
SELECT *
FROM info_countries_2016
ORDER BY ABS(total_area_sq_km-1324449)
```

2. REGIONAL OUTLOOK

WITH

forest_percent_2016

AS

```
(  
  SELECT  
    region,  
    ROUND(((SUM(forest_area_sqkm)/SUM(total_area_sq_km))*100)::numeric,2)  
    Forest_Percentage_2016  
  FROM forestation  
  WHERE year=2016  
  GROUP BY region  
)
```

forest_percent_1990

AS

```
(  
  SELECT  
    region,  
    ROUND(((SUM(forest_area_sqkm)/SUM(total_area_sq_km))*100)::numeric,2)  
    Forest_Percentage_1990  
  FROM forestation  
  WHERE year=1990  
  GROUP BY region)
```

SELECT forest_percent_1990.region, forest_percentage_1990, forest_percentage_2016

FROM forest_percent_1990

JOIN forest_percent_2016

ON forest_percent_1990.region = forest_percent_2016.region

3. COUNTRY-LEVEL DETAIL

A. SUCCESS STORIES

The largest increase in forest area from 1990 to 2016 in km²

WITH

forest_land_2016

AS

(SELECT country_name, region, forest_area_sqkm

FROM forestation

WHERE year=2016),

forest_land_1990

AS

(SELECT country_name, region, forest_area_sqkm

FROM forestation

WHERE year=1990)

SELECT

forest_land_1990.country_name, forest_land_1990.region,

ROUND(forest_land_1990.forest_area_sqkm:: numeric,2) forest_area_sqkm_1990,

ROUND(forest_land_2016.forest_area_sqkm:: numeric,2) forest_area_sqkm_2016,

ROUND((forest_land_2016.forest_area_sqkm -forest_land_1990.forest_area_sqkm):: numeric,2)
forest_diff_km

FROM forest_land_1990

JOIN forest_land_2016

ON forest_land_1990.country_name = forest_land_2016.country_name

WHERE forest_land_1990.country_name!='World'

ORDER BY 5 DESC

LIMIT 5

The largest increase in forest area from 1990 to 2016 in %

```
WITH
forest_land_2016
AS
    (SELECT country_name, forest_area_sqkm
     FROM forestation
     WHERE year=2016),
forest_land_1990
AS
    (SELECT country_name, forest_area_sqkm
     FROM forestation
     WHERE year=1990)
SELECT
    forest_land_1990.country_name country,
    ABS(ROUND((((forest_land_2016.forest_area_sqkm -
forest_land_1990.forest_area_sqkm)/forest_land_1990.forest_area_sqkm)*100)::
numeric,2)) forest_area_change_percent
FROM forest_land_1990
JOIN forest_land_2016
ON forest_land_1990.country_name = forest_land_2016.country_name
WHERE forest_land_1990.country_name!='World'
ORDER BY ROUND
    (((forest_land_2016.forest_area_sqkm -
forest_land_1990.forest_area_sqkm)/forest_land_1990.forest_area_sqkm)*100)::
numeric,2) DESC
LIMIT 5
```

B. LARGEST CONCERNS

Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

WITH

forest_land_2016

AS

(SELECT country_name, region, forest_area_sqkm

FROM forestation

WHERE year=2016

),

forest_land_1990

AS

(SELECT country_name, region, forest_area_sqkm

FROM forestation

WHERE year=1990)

SELECT

forest_land_1990.country_name country, forest_land_1990.region,

ABS(ROUND((forest_land_2016.forest_area_sqkm -forest_land_1990.forest_area_sqkm)::
numeric,2)) absolute_forest_area_change_km

FROM forest_land_1990

JOIN forest_land_2016

ON forest_land_1990.country_name = forest_land_2016.country_name

WHERE forest_land_1990.country_name!='World'

ORDER BY ROUND

((forest_land_2016.forest_area_sqkm -forest_land_1990.forest_area_sqkm):: numeric,2)

LIMIT 5

Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

WITH

forest_land_2016

AS

(SELECT country_name, region, forest_area_sqkm

FROM forestation

WHERE year=2016),

forest_land_1990

AS

(SELECT country_name, region, forest_area_sqkm

FROM forestation

WHERE year=1990)

SELECT

forest_land_1990.country_name country, forest_land_1990.region,

ABS(ROUND((((forest_land_2016.forest_area_sqkm -
forest_land_1990.forest_area_sqkm)/forest_land_1990.forest_area_sqkm)*100):: numeric,2))
forest_area_change_percent

FROM forest_land_1990

JOIN forest_land_2016

ON forest_land_1990.country_name = forest_land_2016.country_name

WHERE forest_land_1990.country_name != 'World'

ORDER BY ROUND

(((((forest_land_2016.forest_area_sqkm -
forest_land_1990.forest_area_sqkm)/forest_land_1990.forest_area_sqkm)*100):: numeric,2)

LIMIT 5

C. QUARTILES

Count of Countries Grouped by Forestation Percent Quartiles, 2016:

WITH land_as_forest_quartile

AS

(SELECT land_as_forest_km_percent,

CASE

WHEN land_as_forest_km_percent<25 THEN '0-25%'

WHEN land_as_forest_km_percent>25 AND
land_as_forest_km_percent<50 THEN '25% -50%'

WHEN land_as_forest_km_percent>50 AND
land_as_forest_km_percent<75 THEN '50% - 75%'

ELSE '75% - 100%'

END AS quartile

FROM forestation

WHERE year=2016)

SELECT quartile, COUNT(quartile)

FROM land_as_forest_quartile

GROUP BY quartile

ORDER BY quartile

Top Quartile Countries, 2016:

```
WITH land_as_forest_quartile
  AS
  (SELECT
    country_name country, region, land_as_forest_km_percent,
    CASE
      WHEN land_as_forest_km_percent<25 THEN '0-25%'
      WHEN land_as_forest_km_percent>25 AND
        land_as_forest_km_percent<50 THEN '25% -50%'
      WHEN land_as_forest_km_percent>50 AND
        land_as_forest_km_percent<75 THEN '50% - 75%'
      ELSE '75% - 100%'
    END AS quartile
  FROM forestation
  WHERE year=2016 )
SELECT country, region, land_as_forest_km_percent pct_designated_as_forest
FROM land_as_forest_quartile
WHERE quartile ='75% - 100%'
ORDER BY 3 DESC
```


Countries Distribution by income grouped by Forestation Percent Quartiles, 1990:

WITH land_as_forest_quartile

AS(

SELECT country_name country, income_group,

region, year, land_as_forest_km_percent,

CASE

WHEN land_as_forest_km_percent<25 THEN '0-25%'

WHEN land_as_forest_km_percent>25 AND
land_as_forest_km_percent<50 THEN '25% -50%'

WHEN land_as_forest_km_percent>50 AND
land_as_forest_km_percent<75 THEN '50% - 75%'

ELSE '75% - 100%'

END AS quartile

FROM forestation

WHERE year=1990)

SELECT DISTINCT

quartile land_as_forest_in_percent,

COUNT(income_group)OVER (PARTITION BY quartile, income_group) AS amount_of_countries,

income_group

FROM land_as_forest_quartile

ORDER BY income_group

Countries Distribution by income grouped by Forestation Percent Quartiles, 2016:

WITH land_as_forest_quartile

AS(

SELECT country_name country, income_group,

region, year, land_as_forest_km_percent,

CASE

WHEN land_as_forest_km_percent<25 THEN '0-25%'

WHEN land_as_forest_km_percent>25 AND
land_as_forest_km_percent<50 THEN '25% -50%'

WHEN land_as_forest_km_percent>50 AND
land_as_forest_km_percent<75 THEN '50% - 75%'

ELSE '75% - 100%'

END AS quartile

FROM forestation

WHERE year=2016)

SELECT DISTINCT

quartile land_as_forest_in_percent,

COUNT(income_group)OVER (PARTITION BY quartile, income_group) AS amount_of_countries,

income_group

FROM land_as_forest_quartile

ORDER BY income_group