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 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to39958245.9 sqkm, a loss of 1324449 sqkm, 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 1279999.99sqkm).

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

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 527229.06sqkm. 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 79200sqkm, 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 213.66% 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 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 sqkm |
| Indonesia | East Asia & Pacific | 282194 sqkm |
| Myanmar | East Asia & Pacific | 107234 sqkm |
| Nigeria | Sub-Saharan Africa | 106506 sqkm |
| Tanzania | Sub-Saharan Africa | 102320 sqkm |

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 |
| 1 | 85 |
| 2 | 72 |
| 3 | 38 |
| 4 | 9 |

The largest number of countries in 2016 were found in the 1st 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 |
| Solomon Islands | East Asia & Pacific | 77.86% |
| Lao PDR | East Asia & Pacific | 82.11% |
| Guyana | Latin America & Caribbean | 83.90% |
| American Samoa | East Asia & Pacific | 87.50% |
| Palau | East Asia & Pacific | 87.61% |
| Seychelles | Sub-Saharan Africa | 88.41% |
| Gabon | Sub-Saharan Africa | 90.04% |
| Micronesia, Fed. Sts. | East Asia & Pacific | 91.86% |
| Suriname | Latin America & Caribbean | 98.26% |

## 5. 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?*

According to World Bank data from 1990 to 2016, our world forest area is shrinking due to forest area loss of two regions Sub-Saharan Africa and Latin America & Caribbean. All other regions increased in forest area over this time period.

The data suggest that, we should focus on the countries facing major decrement in forest area. Those countries are Brazil, Indonesia, Myanmar, Nigeria, and Tanzania (Table 3.1). Countries like Togo, Nigeria, Uganda, Mauritania, Honduras also at risk for loosing high percentage of forest (Table 3.2) which may impact them as individual. Nigeria is the most concerned country to be focus on and needs initiative as quickly as possible in order to sustain. We can start campaign to understand the exact situation over here.

As a success China has shown remarkable increase in its forest land. Hence, we should acquire some best practices from them to implement. As a whole world initiative, we should enforce some rules for all countries to protect their forest.

## APPENDIX: SQL queries used

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--Deforestation Exploration

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--Prechecks :

--No duplicates for country and years present.

--Drop forestation view if existing before creation.

DROP VIEW forestation;

--Create/Replace forestation view.

--Conversion applied as 1 sq mi = 2.59 sq km

CREATE VIEW forestation AS

SELECT r.country\_code AS country\_code,

r.country\_name AS country\_name,

f.year AS in\_year,

f.forest\_area\_sqkm AS forest\_area\_sqkm,

l.total\_area\_sq\_mi AS total\_area\_sq\_mi,

r.region AS region,

r.income\_group reg\_income\_group,

(forest\_area\_sqkm/(total\_area\_sq\_mi\*2.59))\*100 AS percent\_of\_l\_as\_f

FROM forest\_area f

JOIN land\_area l

ON f.country\_code = l.country\_code AND f.year = l.year

FULL JOIN regions r

ON r.country\_code = f.country\_code

ORDER BY r.country\_code;

--view data for forestation

select \* from forestation;

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--1. GLOBAL SITUATION

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--(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 forest\_area\_sqkm

FROM forestation f

WHERE in\_year = 1990 AND country\_name = 'World';

--Result: 41282694.9 sqkm

--(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 forest\_area\_sqkm

FROM forestation f

WHERE in\_year = 2016 AND country\_name = 'World';

--Result : 39958245.9 sqkm

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

SELECT forest\_area\_sqkm -

(SELECT forest\_area\_sqkm

FROM forestation f

WHERE in\_year = 2016 AND country\_name = 'World') f\_area\_diff

FROM forestation f

WHERE in\_year = 1990 AND country\_name = 'World';

--Result: 1324449 sqkm

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

WITH t1 AS

(SELECT country\_name, forest\_area\_sqkm AS f\_area16\_sqkm

FROM forestation f

WHERE in\_year = 2016 AND country\_name = 'World'

),

t2 AS (

SELECT country\_name, forest\_area\_sqkm AS f\_area90\_sqkm

FROM forestation f

WHERE in\_year = 1990 AND country\_name = 'World'

)

SELECT ((t2.f\_area90\_sqkm - t1.f\_area16\_sqkm)/t2.f\_area90\_sqkm)\*100 AS pecent\_change

FROM t1

JOIN t2

ON t1.country\_name = t2.country\_name

--result: 3.2 %

--- (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?

WITH t1 AS(

SELECT country\_name, forest\_area\_sqkm

FROM forestation

WHERE in\_year = 2016 AND country\_name = 'World'

),

t2 AS (

SELECT country\_name, forest\_area\_sqkm

FROM forestation

WHERE in\_year = 1990 AND country\_name = 'World'

),

t3 AS (

SELECT t1.country\_name, t2.forest\_area\_sqkm - t1.forest\_area\_sqkm as loss\_90\_16

FROM t1

JOIN t2

ON t1.country\_name = t2.country\_name

)

/\*Calculate the lowest difference between forest area lost and total area of each country as listed in 2016.\*/

SELECT country\_name, (total\_area\_sq\_mi\*2.59) AS total\_area\_in\_sqkm,

ABS((total\_area\_sq\_mi \* 2.59) - (SELECT loss\_90\_16 FROM t3)) AS diff

FROM forestation

WHERE in\_year = 2016

ORDER BY diff ASC

LIMIT 1

/\*

Result : Peru 1279999.99sqkm

\*/

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--2. REGIONAL OUTLOOK

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--- (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?

WITH t\_data16 AS (

SELECT region,

(SUM(forest\_area\_sqkm) / SUM(total\_area\_sq\_mi\*2.59))\*100 as prcnt\_forest\_16

FROM forestation

WHERE in\_year = 2016

GROUP BY region

)

SELECT region, ROUND(CAST(prcnt\_forest\_16 AS numeric),2) as r\_prcnt\_forest\_16

FROM t\_data16

ORDER BY r\_prcnt\_forest\_16

/\* Result:

region r\_prcnt\_forest\_16

Middle East & North Africa 2.07

South Asia 17.51

East Asia & Pacific 26.36

Sub-Saharan Africa 28.79

World 31.38

North America 36.04

Europe & Central Asia 38.04

Latin America & Caribbean 46.16

\*/

--- (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?

WITH t\_data90 AS (

SELECT region,

(SUM(forest\_area\_sqkm) / SUM(total\_area\_sq\_mi\*2.59))\*100 as prcnt\_forest\_90

FROM forestation

WHERE in\_year = 1990

GROUP BY region

)

SELECT region, ROUND(CAST(prcnt\_forest\_90 AS numeric),2) as r\_prcnt\_forest\_90

FROM t\_data90

ORDER BY r\_prcnt\_forest\_90

/\*

region r\_prcnt\_forest\_90

Middle East & North Africa 1.78

South Asia 16.51

East Asia & Pacific 25.78

Sub-Saharan Africa 30.67

World 32.42

North America 35.65

Europe & Central Asia 37.28

Latin America & Caribbean 51.03

\*/

--- (c) Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

WITH t\_data16 AS (

SELECT region,

(SUM(forest\_area\_sqkm) / SUM(total\_area\_sq\_mi\*2.59))\*100 as prcnt\_forest\_16

FROM forestation

WHERE in\_year = 2016

GROUP BY region

),

t\_data90 AS (

SELECT region,

(SUM(forest\_area\_sqkm) / SUM(total\_area\_sq\_mi\*2.59))\*100 as prcnt\_forest\_90

FROM forestation

WHERE in\_year = 1990

GROUP BY region

)

SELECT t\_data90.region, ROUND(CAST(prcnt\_forest\_90 AS numeric),2) as r\_prcnt\_forest\_90,

ROUND(CAST(prcnt\_forest\_16 AS numeric),2) as r\_prcnt\_forest\_16

FROM t\_data16

JOIN t\_data90

ON t\_data90.region = t\_data16.region

WHERE ROUND(CAST(prcnt\_forest\_90 AS numeric),2) > ROUND(CAST(prcnt\_forest\_16 AS numeric),2)

AND t\_data90.region != 'World'

ORDER BY r\_prcnt\_forest\_90;

/\* Result:

region r\_prcnt\_forest\_90 r\_prcnt\_forest\_16

Sub-Saharan Africa 30.67 28.79

Latin America & Caribbean 51.03 46.16

\*/

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--3. COUNTRY-LEVEL DETAIL

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--- (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 t1990 AS (

SELECT country\_code,

country\_name,

region,

forest\_area\_sqkm

FROM forestation fa

WHERE in\_year = 1990 AND forest\_area\_sqkm IS NOT NULL AND country\_name != 'World'

),

t2016 AS (

SELECT country\_code,

country\_name,

region,

forest\_area\_sqkm

FROM forestation fa

WHERE in\_year = 2016 AND forest\_area\_sqkm IS NOT NULL AND country\_name != 'World'

)

SELECT t2016.country\_code,

t2016.country\_name,

t2016.region,

t1990.forest\_area\_sqkm - t2016.forest\_area\_sqkm AS change\_sqkm

FROM t1990

JOIN t2016

ON t1990.country\_code = t2016.country\_code

AND (t1990.forest\_area\_sqkm IS NOT NULL AND t2016.forest\_area\_sqkm IS NOT NULL)

ORDER BY 4 DESC

LIMIT 5;

/\*

Result:

country\_code country\_name region change\_sqkm

BRA Brazil Latin America & Caribbean 541510

IDN Indonesia East Asia & Pacific 282193.9844

MMR Myanmar East Asia & Pacific 107234.0039

NGA Nigeria Sub-Saharan Africa 106506.001

TZA Tanzania Sub-Saharan Africa 102320

\*/

-- calculating countries saw the **largest increase** in forest area.

/\*

country\_code country\_name region change\_sqkm

CHN China East Asia & Pacific 527229.062

USA United States North America 79200

\*/

-- 2 largest countries in total land area (Extra query)

SELECT country\_name,

MAX(total\_area\_sq\_mi) as tol\_l\_area

FROM forestation f

WHERE country\_name != 'World'

AND total\_area\_sq\_mi IS NOT NULL

GROUP BY country\_name

ORDER BY 2 DESC

LIMIT 2;

/\*

Russian Federation 6328166.02

China 3624806.95

\*/

--- (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 t1990 AS (

SELECT country\_code,

country\_name,

region,

forest\_area\_sqkm

FROM forestation

WHERE in\_year = 1990 AND forest\_area\_sqkm IS NOT NULL AND country\_name != 'World'

),

t2016 AS (

SELECT country\_code,

country\_name,

region,

forest\_area\_sqkm

FROM forestation

WHERE in\_year = 2016 AND forest\_area\_sqkm IS NOT NULL AND country\_name != 'World'

)

SELECT t2016.country\_code,

t2016.country\_name,

t2016.region,

ROUND(CAST((((t1990.forest\_area\_sqkm - t2016.forest\_area\_sqkm)/t1990.forest\_area\_sqkm)\*100) AS numeric),2) AS percnt\_change

FROM t1990

JOIN t2016

ON t1990.country\_code = t2016.country\_code

AND (t1990.forest\_area\_sqkm IS NOT NULL AND t2016.forest\_area\_sqkm IS NOT NULL)

ORDER BY 4 DESC

LIMIT 5;

/\*

Result :

country\_code country\_name region percnt\_change

TGO Togo Sub-Saharan Africa 75.45

NGA Nigeria Sub-Saharan Africa 61.80

UGA Uganda Sub-Saharan Africa 59.13

MRT Mauritania Sub-Saharan Africa 46.75

HND Honduras Latin America & Caribbean 45.03

\*/

--- (c) If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

WITH tbl\_2016 AS (

SELECT

country\_code,

country\_name,forest\_area\_sqkm, total\_area\_sq\_mi, percent\_of\_l\_as\_f, in\_year

FROM forestation

WHERE country\_name != 'World' AND percent\_of\_l\_as\_f IS NOT NULL AND total\_area\_sq\_mi IS NOT NULL

AND in\_year = 2016

ORDER BY percent\_of\_l\_as\_f DESC

),

tbl\_quartile AS (

SELECT country\_code,

country\_name,

forest\_area\_sqkm,

total\_area\_sq\_mi,

percent\_of\_l\_as\_f,

in\_year,

CASE WHEN percent\_of\_l\_as\_f > 0 AND percent\_of\_l\_as\_f <= 25 THEN 1

WHEN percent\_of\_l\_as\_f > 25 AND percent\_of\_l\_as\_f <= 50 THEN 2

WHEN percent\_of\_l\_as\_f > 50 AND percent\_of\_l\_as\_f <= 75 THEN 3

WHEN percent\_of\_l\_as\_f > 75 AND percent\_of\_l\_as\_f <= 100 THEN 4

END AS quartile\_num

FROM tbl\_2016

)

SELECT quartile\_num, count(\*) as tol\_num\_of\_country

FROM tbl\_quartile

GROUP BY quartile\_num

ORDER BY 2 DESC;

/\*Result:

quartile\_num tol\_num\_of\_country

1 85

2 72

3 38

4 9

\*/

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

WITH tbl\_2016 AS (

SELECT

country\_code,

country\_name,

region,

forest\_area\_sqkm,

total\_area\_sq\_mi,

percent\_of\_l\_as\_f,

in\_year

FROM forestation

WHERE country\_name != 'World' AND forest\_area\_sqkm IS NOT NULL AND total\_area\_sq\_mi IS NOT NULL

AND in\_year = 2016

ORDER BY percent\_of\_l\_as\_f DESC

),

tbl\_quartile AS (

SELECT

country\_code,

country\_name,

region,

forest\_area\_sqkm,

total\_area\_sq\_mi,

percent\_of\_l\_as\_f,

in\_year,

CASE WHEN percent\_of\_l\_as\_f > 0 AND percent\_of\_l\_as\_f <= 25 THEN 1

WHEN percent\_of\_l\_as\_f > 25 AND percent\_of\_l\_as\_f <= 50 THEN 2

WHEN percent\_of\_l\_as\_f > 50 AND percent\_of\_l\_as\_f <= 75 THEN 3

WHEN percent\_of\_l\_as\_f > 75 AND percent\_of\_l\_as\_f <= 100 THEN 4

END AS quartile\_num

FROM tbl\_2016

)

SELECT

country\_name,

region,

ROUND(CAST(percent\_of\_l\_as\_f AS numeric),2) AS pct\_of\_l\_as\_f

FROM tbl\_quartile

WHERE quartile\_num = 4

ORDER BY 3;

/\*Result:

country\_name region pct\_of\_l\_as\_f

Solomon Islands East Asia & Pacific 77.86

Lao PDR East Asia & Pacific 82.11

Guyana Latin America & Caribbean 83.90

American Samoa East Asia & Pacific 87.50

Palau East Asia & Pacific 87.61

Seychelles Sub-Saharan Africa 88.41

Gabon Sub-Saharan Africa 90.04

Micronesia, Fed. Sts. East Asia & Pacific 91.86

Suriname Latin America & Caribbean 98.26

\*/

--- (e) How many countries had a percent forestation higher than the United States in 2016?

WITH tbl\_2016 AS (

SELECT

country\_code,

country\_name,

region,

forest\_area\_sqkm,

total\_area\_sq\_mi,

percent\_of\_l\_as\_f,

in\_year

FROM forestation

WHERE country\_name != 'World' AND forest\_area\_sqkm IS NOT NULL AND total\_area\_sq\_mi IS NOT NULL

AND in\_year = 2016

ORDER BY percent\_of\_l\_as\_f DESC

)

SELECT

count(country\_name)

FROM tbl\_2016

WHERE percent\_of\_l\_as\_f > (SELECT percent\_of\_l\_as\_f FROM tbl\_2016

WHERE country\_code = 'USA')

/\*Result:

count

94

\*/

/\*END of Queries\*/