## **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 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  **41,282,695 km2** in 1990. Asof 2016, the most recent year for which data was available, that number had fallen to **39,958,246 km2,** a loss of **1,324,449 km2**, or **3.21 %**.

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 **738,054 km2**).

## **2. REGIONAL OUTLOOK**

In 2016, the percentage of 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 percentage of 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** |
| 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 %**.

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## **3. COUNTRY-LEVEL DETAIL**

### **A. SUCCESS STORIES**

There is one particularly bright spot in the data at the country level, **China**. The forest area in China increased from 1990 to 2016 by **527,230**  **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 USA, but it only saw an increase of **79,200 km2**, much lower than the figure for China.

China and The US 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 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** |
| Brazil | Latin America & Caribbean | 541,510 km2 |
| Indonesia | East Asia & Pacific | 282,194 km2 |
| Myanmar | East Asia & Pacific | 107,234 km2 |
| Nigeria | Sub-Saharan Africa | 106,506 km2 |
| Tanzania | Sub-Saharan Africa | 102,320 km2 |

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 | 75.00 % |
| Nigeria | Sub-Saharan Africa | 62.00 % |
| Uganda | Sub-Saharan Africa | 59.00 % |
| Mauritania | Sub-Saharan Africa | 47.00 % |
| Honduras | Latin America & Caribbean | 45.00 % |

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** | **Number of Countries** |
| 4th | **9** |
| 3rd | **38** |
| 2nd | **72** |
| 1st | **85** |

Quartiles:

4th: greater than 75%   
3th: less than 75% - greater than 50%   
2nd: less than 50% - greater than 25%  
1st: less than 25%

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** | **% 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 |

There are **94 countries** with a larger forestation percentage larger than that of the United States.

## **5. RECOMMENDATIONS**

Since 1990, the global forest area has declined by 3.21% or over 1.3 million km2. This is roughly equal to the total area of Peru.

Not surprisingly, the area with the largest percentage of forests remains Latin America and the Caribbean, home to the Amazon forest and the forests of Central America. Sadly, this was the area with the largest deforestation measured, dropping from 51.03% in 1990 to 46.16% in 2016, with **Brazil** losing half a million km2 of forests.  
**Indonesia**, **Myanmar**, **Nigeria** and **Tanzania** complete the top five countries with the largest loss. The top 5 countries contain some of the world’s largest rainforests, which indicates that most of the deforestation is caused by logging and exploitation of natural resources in these forests.

Sub-Saharan Africa is another area of great concern with 4 countries that have lost the most forest per total area: **Togo, Nigeria, Uganda,** and **Mauritania,** losing 75%, 62%, 59% and 47% respectively.   
These numbers are catastrophic and are not global headlines because the total forested area in these countries is small compared to Brazil, Russia, China, and the US. However, looked as a whole, Sub-Saharan Africa is in the process of a catastrophic and perhaps irreversible deforestation.

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

We first must focus efforts on stopping deforestation in Latin America and the Caribbean, since it contains the largest forest area. Any percentage improvement in this area will translate to the largest net forest area saved or restored.  
Additionally, countries with large rainforest areas ( Indonesia, Myanmar, etc.) should be part of the top tier of protection along with Latin America. A successful conservation program in any of these countries will translate to millions of saved forest square kilometers.

Regionally, the countries of Sub-Saharan Africa will require a monumental effort as some of them have lost most of their forests. This region will require a multi-nation effort to restore forests to 1990 levels.

## **5. Queries**

**Create Deforestation View**

|  |
| --- |
| DROP VIEW IF EXISTS forestation; CREATE VIEW forestation AS SELECT fa.country\_code AS "country\_code",   fa.country\_name AS "country\_name",  fa.year AS "year",  fa.forest\_area\_sqkm AS "forest\_area",  (la.total\_area\_sq\_mi \* 2.59 ) AS "total\_area",  rg.region AS "region",  rg.income\_group AS "income\_group",  ROUND((fa.forest\_area\_sqkm / (la.total\_area\_sq\_mi \* 2.59 ) ) \* 100 , 2) AS "percentage\_forest" FROM forest\_area fa  JOIN land\_area la  ON la.country\_code = fa.country\_code AND fa.year = la.year  JOIN regions as rg  ON rg.country\_code = la.country\_code; |

**Global Situation**

**a. What was the total forest area (in sq km) of the world in 1990?**

|  |
| --- |
| SELECT fa.forest\_area\_sqkm  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 1990 |

**b. What was the total forest area (in sq km) of the world in 2016?**

|  |
| --- |
| SELECT fa.forest\_area\_sqkm  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 2016 |

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

|  |
| --- |
| SELECT   (SELECT fa.forest\_area\_sqkm AS total\_1990  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 1990)    - (SELECT fa.forest\_area\_sqkm AS total\_2016  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 2016)  AS change\_forest\_area\_sqkm |

|  |
| --- |
| --- From View --- SELECT   (SELECT forest\_area AS total\_1990  FROM forestation   WHERE country\_name = 'World' AND year = 1990)    - (SELECT forest\_area   FROM forestation  WHERE country\_name = 'World' AND year = 2016) AS change\_forest\_area |

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

|  |
| --- |
| SELECT   (  (   (SELECT fa.forest\_area\_sqkm AS total\_1990  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 1990)    - (SELECT fa.forest\_area\_sqkm AS total\_2016  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 2016)  )/  (  (SELECT fa.forest\_area\_sqkm AS total\_1990  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 1990)    ) )\* 100 AS percentage\_change\_forest\_area\_sqkm |

**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 change\_forest\_area\_sqkm AS  (SELECT   (  (SELECT fa.forest\_area\_sqkm AS total\_1990  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 1990)    - (SELECT fa.forest\_area\_sqkm AS total\_2016  FROM forest\_area fa  JOIN regions rg  ON rg.country\_code = fa.country\_code  WHERE rg.country\_name = 'World' AND fa.year = 2016)   ) / 2.59 AS difference  ),  country\_total\_area AS   (SELECT country\_name,  total\_area\_sq\_mi  FROM land\_area  WHERE year = 2016)  SELECT country\_name,  ABS(total\_area\_sq\_mi -   (select difference   FROM change\_forest\_area\_sqkm)) AS substraction FROM country\_total\_area ORDER BY substraction LIMIT 1 |

**Regional Outlook**

**Create a table that shows the Regions and their percent forest area in 1990 and 2016**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM  (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" IN (1990, 2016) AND region != 'World'  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY region, year; |

**2016**

**In 2016, the percent of the total land area of the world designated as forest was**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM  (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" = 2016 AND region = 'World'  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY region, year; |

**The region with the highest relative forestation was , with :**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM  (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" = 2016  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY Regional\_forest\_percentage DESC LIMIT 1; |

**And the region with the lowest relative forestation was with % forestation.**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM  (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" = 2016  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY Regional\_forest\_percentage ASC LIMIT 1; |

**1990**

**In 1990, the percent of** **the total land area of the world designated as forest was**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" = 1990 AND region = 'World'  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY region, year; |

**The region with the highest relative forestation was**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM  (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" = 1990  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY Regional\_forest\_percentage DESC LIMIT 1 |
|  |

**and the region with the lowest relative forestation was**

|  |
| --- |
| SELECT region,   SUM(forest\_percentage) AS Regional\_forest\_percentage,  "year" FROM  (SELECT region,  ROUND(SUM(forest\_area) / SUM(total\_area) \* 100 , 2) AS forest\_percentage,  "year"  FROM forestation  WHERE "year" = 1990  GROUP BY "year", "region"  ORDER BY "year") AS "years\_regions" GROUP BY region, year ORDER BY Regional\_forest\_percentage ASC LIMIT 1 |

**Country-level Details**

**Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?**

|  |
| --- |
| SELECT f1.country\_code,  f1.forest\_area,  f2.country\_name,  f2.forest\_area,  f1.forest\_area - f2.forest\_area as forest\_area\_change FROM forestation f1  LEFT JOIN forestation f2  ON f1.country\_code = f2.country\_code  AND f1.year = 1990  AND f1.country\_code != 'WLD'  AND f2.year = 2016  AND f2.country\_name != 'World'  WHERE f1.forest\_area IS NOT NULL  AND f2.forest\_area IS NOT NULL ORDER BY forest\_area\_change DESC LIMIT 5 |

**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?**

|  |
| --- |
| SELECT f1.country\_code,  f1.percentage\_forest,   f2.percentage\_forest,  f2.country\_name,  f1.percentage\_forest - f2.percentage\_forest as forest\_area\_change FROM forestation f1  LEFT JOIN forestation f2  ON f1.country\_code = f2.country\_code  AND f1.year = 1990  AND f2.year = 2016  WHERE f1.percentage\_forest IS NOT NULL  AND f2.percentage\_forest IS NOT NULL ORDER BY forest\_area\_change DESC LIMIT 5 |

**Table 3.1**

|  |
| --- |
| SELECT f2.country\_name,  f1.region,  f1.forest\_area - f2.forest\_area as forest\_area\_change FROM forestation f1  LEFT JOIN forestation f2  ON f1.country\_code = f2.country\_code  AND f1.year = 1990  AND f1.country\_code != 'WLD'  AND f2.year = 2016  AND f2.country\_name != 'World'  WHERE f1.forest\_area IS NOT NULL  AND f2.forest\_area IS NOT NULL ORDER BY forest\_area\_change DESC LIMIT 5 |

**Table 3.2**

|  |
| --- |
| SELECT f2.country\_name,  f1.region,  ((f2.forest\_area - f1.forest\_area) / f1.forest\_area) \* 100 as forest\_area\_change FROM forestation f1  LEFT JOIN forestation f2  ON f1.country\_code = f2.country\_code  AND f1.year = 1990  AND f1.country\_code != 'WLD'  AND f2.year = 2016  AND f2.country\_name != 'World'  WHERE f1.forest\_area IS NOT NULL  AND f2.forest\_area IS NOT NULL ORDER BY forest\_area\_change ASC LIMIT 5 |

**If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?**

|  |
| --- |
| WITH   forest1 AS  (SELECT \*  FROM forestation  WHERE year = 2016  AND percentage\_forest IS NOT NULL  AND region != 'World'),   quartile AS   (SELECT \*,  CASE  WHEN percentage\_forest > 75  THEN '4th'  WHEN percentage\_forest <= 75 AND percentage\_forest > 50  THEN '3rd'  WHEN percentage\_forest <= 50 AND percentage\_forest > 25  THEN '2nd'  ELSE '1st'  END AS quarter  FROM forest1 )  SELECT quarter,  COUNT(\*) FROM quartile GROUP BY quarter ORDER BY 2 DESC; |

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

|  |
| --- |
| WITH   forest1 AS  (SELECT \*  FROM forestation  WHERE year = 2016  AND percentage\_forest IS NOT NULL  AND region != 'World'),   quartile AS   (SELECT \*,  CASE  WHEN percentage\_forest > 75  THEN '4th'  WHEN percentage\_forest <= 75 AND percentage\_forest > 50  THEN '3rd'  WHEN percentage\_forest <= 50 AND percentage\_forest > 25  THEN '2nd'  ELSE '1st'  END AS quarter  FROM forest1 )  SELECT country\_name,  region,  percentage\_forest  FROM quartile  WHERE quarter = '4th'  ORDER BY percentage\_forest DESC |

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

|  |
| --- |
| SELECT count(\*) FROM forestation WHERE percentage\_forest >  (SELECT percentage\_forest   FROM forestation  WHERE year = 2016  AND country\_code = 'USA')  AND year = 2016 |

**Table 3.3**

|  |
| --- |
| WITH   forest1 AS  (SELECT \*  FROM forestation  WHERE year = 2016  AND percentage\_forest IS NOT NULL  AND region != 'World'),   quartile AS   (SELECT \*,  CASE  WHEN percentage\_forest > 75  THEN '4th'  WHEN percentage\_forest <= 75 AND percentage\_forest > 50  THEN '3rd'  WHEN percentage\_forest <= 50 AND percentage\_forest > 25  THEN '2nd'  ELSE '1st'  END AS quarter  FROM forest1 )  SELECT quarter,  COUNT(\*) FROM quartile GROUP BY quarter ORDER BY quarter; |

**Table 3.4**

|  |
| --- |
| **WITH   forest1 AS  (SELECT \*  FROM forestation  WHERE year = 2016  AND percentage\_forest IS NOT NULL  AND region != 'World'),   quartile AS   (SELECT \*,  CASE  WHEN percentage\_forest > 75  THEN '4th'  WHEN percentage\_forest <= 75 AND percentage\_forest > 50  THEN '3rd'  WHEN percentage\_forest <= 50 AND percentage\_forest > 25  THEN '2nd'  ELSE '1st'  END AS quarter  FROM forest1 )  SELECT country\_name,  region,  percentage\_forest  FROM quartile  WHERE quarter = '4th'  ORDER BY percentage\_forest DESC** |