# 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 to ***39958245.9 sqkm***, a loss of ***1324449 sqkm***, or ***3.208***%.

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 sqkm***).

## 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*** |
| ***North America*** | ***35.65*** | ***36.04*** |
| ***Europe & Central Asia*** | ***37.28*** | ***38.04*** |
| ***Latin America & Caribbean*** | ***51.03*** | ***46.16*** |
| ***World*** | ***32.42*** | ***31.38*** |

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 sqkm***. 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 sqkm***, 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.

## 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*** | ***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 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 |
|---|---|
| ***9*** | ***4th quartile*** |
| ***38*** | ***3rd quartile*** |
| ***72*** | ***2nd quartile*** |
| ***85*** | ***1st quartile*** |

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 |
|---|---|---|
| ***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.*

***1st Question***
*What have you learned from the World Bank data?*

*According to World Bank Data, the countries with the most considerable percentage decrease in forest area are from the Sub-Saharan region. Furthermore, most countries (1st and 2nd quartile - table 3.3) demonstrated a small forestation percentage in 2016, which is quite alarming. In addition, regions like Latin America & the Caribbean and Sub-Saharan Africa show a decrease in forest percentage from 1990 to 2016, which was so big (in absolute number of forest land area) that the slight increase in forest percentage in all the other regions could not deter the downtrend of forestation in the World. The country with the most prominent concerns around deforestation is Brazil, while China is a country that interestingly increased its forest (from 1990 to 2016) more than any country in the World.*

***2nd Question***
*Which countries should we focus on over others?*

Table 4.1

| *Number of countries (2016)* | *Quartile* | *Region* |
|---|---|---|
| ***26*** | *2nd quartile* | *Europe & Central Asia* |
| ***22*** | *1st quartile* | *Sub-Saharan Africa* |
| ***22*** | *1st quartile* | *Europe & Central Asia* |
| ***20*** | *1st quartile* | *Middle East & North Africa* |
| ***15*** | *2nd quartile* | *Sub-Saharan Africa* |

Table 4.2

| *Number of countries (2016)* | *Quartile* | *Region* | **Income Group** |
|---|---|---|---|
| **17** | 2nd quartile | Europe & Central Asia | High income |
| **13** | 1st quartile | Sub-Saharan Africa | Low income |
| **12** | 1st quartile | Europe & Central Asia | High income |
| **10** | 2nd quartile | Sub-Saharan Africa | Low income |

*According to the tables above, most countries in the first and second quartiles of forest land (in percentage) are in Europe, Central Asia, and Sub-Saharan Africa. In particular, low-income countries of the Sub-Saharan Africa region demonstrate less than fifty per cent of land*

*designated as forest, probably due to climate but also to poor treatment of the environment. On the other hand, the same pattern applies to the high-income countries of the Europe and Central Asia region. Possible reasons could be overpopulation, heavy urbanisation and industrialisation, which often exist in high-income countries.*

*Of course, some exceptions from other regions are of significant importance. For example, Brazil is one of the countries that have one of the most prominent deforestation issues. Indonesia and Myanmar follow it in terms of the amount of decrease in forest area (table 3.1). Lastly, Honduras is a country that lost 45% of its forest area from 1990 to 2016 (table 3.2).*

*To sum up, one should focus on the Sub-Saharan countries of low income, with some exceptions in Latin America, the Caribbean, East Asia and the Pacific. As for the region of Europe and Central Asia, one should consider how to tackle deforestation issues, mainly in high-income countries.*

# 5. APPENDIX: SQL Queries Used

## *Query for creating the forestation view:*

```
CREATE VIEW forestation AS
SELECT f.year, f.country_code, f.country_name, f.forest_area_sqkm, l.total_area_sq_mi,
r.region, r.income_group,
(f.forest_area_sqkm/(l.total_area_sq_mi*2.59))*100 AS percent_of_forest_in_land
FROM forest_area f
INNER JOIN land_area l
ON f.country_code=l.country_code
AND f.year=l.year
INNER JOIN regions r
ON f.country_code=r.country_code
```

## *Global section Queries:*

***1st Query***

```
SELECT country_name, year, forest_area_sqkm, percent_of_forest_in_land,
forest_area_sqkm-LAG(f.forest_area_sqkm) OVER(ORDER BY f.year)
difference_between_1990_2016_of_forest_area,
((forest_area_sqkm-LAG(f.forest_area_sqkm) OVER(ORDER BY
f.year))/LAG(f.forest_area_sqkm) OVER(ORDER BY f.year))*100
Percent_diff_1990_2016_of_forest_area

FROM forestation f
WHERE country_name='World' AND (year=1990 OR year=2016)
```

***2nd Query***

```
SELECT country_name, total_area_sq_mi*2.59 AS total_area_sqkm
FROM forestation f
WHERE  total_area_sq_mi*2.59<=1324449 AND year=2016
ORDER BY total_area_sqkm DESC
LIMIT 1;
```

***3rd Query - Demonstration of self-join in 1c question***

```
SELECT b.forest_area_sqkm-a.forest_area_sqkm
difference_between_1990_2016_of_forest_area_world_region

FROM forestation a
INNER JOIN forestation b
ON a.country_name=b.country_name
WHERE a.country_name='World' AND a.year=1990
```

```
AND b.country_name='World' AND b.year=2016
```

## *Regional section Queries:*

***1st Query***

```
SELECT region, year,
SUM(forest_area_sqkm)  total_forest_area_byregion_sqkm,
SUM(total_area_sq_mi*2.59) total_land_area_byregion_sqkm,
CAST((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS DECIMAL(5,2))
percent_forest_area
FROM forestation f
WHERE (year=1990 OR year=2016)
GROUP BY region, year
ORDER BY percent_forest_area, region, year
```

***2nd Query***

```
SELECT region, year,
SUM(forest_area_sqkm)  total_forest_area_byregion_sqkm,
SUM(total_area_sq_mi*2.59) total_land_area_byregion_sqkm,
CAST((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS DECIMAL(5,2))
percent_forest_area
FROM forestation f
WHERE region='World' AND (year=2016 OR year=1990)
GROUP BY region, year
```

***3rd Query (Highest Percent forest 2016 & 1990)***

```
SELECT region, year,
SUM(forest_area_sqkm)  total_forest_area_byregion_sqkm,
SUM(total_area_sq_mi*2.59) total_land_area_byregion_sqkm,
CAST((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS DECIMAL(5,2))
percent_forest_area
FROM forestation f
WHERE (year=1990 OR year=2016)
GROUP BY region, year
ORDER BY percent_forest_area DESC, region, year
LIMIT 2;
```

***4th Query (Lowest Percent forest 2016 & 1990)***

```
SELECT region, year,
SUM(forest_area_sqkm)  total_forest_area_byregion_sqkm,
SUM(total_area_sq_mi*2.59) total_land_area_byregion_sqkm,
CAST((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS DECIMAL(5,2))
percent_forest_area
FROM forestation f
```

```
WHERE (year=1990 OR year=2016)
GROUP BY region, year
ORDER BY percent_forest_area ASC, region, year
LIMIT 2;
```

***5th Query***

```
WITH region2016_table AS
(SELECT region, year,
SUM(forest_area_sqkm)  total_forest_area_byregion_sqkm_2016,
SUM(total_area_sq_mi*2.59) total_land_area_byregion_sqkm_2016,
CAST((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS DECIMAL(5,2))
percent_forest_area_2016
FROM forestation f
WHERE  year=2016
GROUP BY region, year),

region1990_table AS
(SELECT region, year,
SUM(forest_area_sqkm)  total_forest_area_byregion_sqkm_1990,
SUM(total_area_sq_mi*2.59) total_land_area_byregion_sqkm_1990,
CAST((SUM(forest_area_sqkm)/SUM(total_area_sq_mi*2.59))*100 AS DECIMAL(5,2))
percent_forest_area_1990
FROM forestation f
WHERE  year=1990
GROUP BY region, year)

SELECT region2016_table.region, total_forest_area_byregion_sqkm_2016,
total_forest_area_byregion_sqkm_1990, total_land_area_byregion_sqkm_2016,
total_land_area_byregion_sqkm_1990, percent_forest_area_2016, percent_forest_area_1990,
CASE WHEN percent_forest_area_1990-percent_forest_area_2016>0 THEN 'DECREASE'
ELSE 'INCREASE' END AS forestation_trend
FROM region2016_table
INNER JOIN region1990_table
ON region2016_table.region=region1990_table.region
ORDER BY percent_forest_area_2016, percent_forest_area_1990
```

## *Country section Queries:*

***A PART***

***1st Query***

```
SELECT *,
CAST(100*(f_area_2016-f_area_1990)/f_area_1990 AS DECIMAL (5,2)) AS
forest_percentage_change_from1990_to2016,
f_area_2016-f_area_1990 AS forest_area_change_from1990_to2016
```

```
FROM
(SELECT country_name, region,
forest_area_sqkm AS f_area_2016,
percent_of_forest_in_land AS f_perc_area_2016
FROM forestation
WHERE year=2016 AND country_name != 'World'
ORDER BY country_name) AS t_2016

INNER JOIN
(SELECT country_name, region,
forest_area_sqkm AS f_area_1990,
percent_of_forest_in_land AS f_perc_area_1990
FROM forestation
WHERE year=1990 AND country_name != 'World'
ORDER BY country_name) AS t_1990

ON t_2016.country_name=t_1990.country_name
AND t_2016.region=t_1990.region
WHERE (f_area_2016-f_area_1990) IS NOT NULL
ORDER BY  forest_area_change_from1990_to2016   DESC
```

***2nd Query***

```
SELECT *,
CAST(100*(f_area_2016-f_area_1990)/f_area_1990 AS DECIMAL (5,2)) AS
forest_percentage_change_from1990_to2016,
f_area_2016-f_area_1990 AS forest_area_change_from1990_to2016

FROM
(SELECT country_name, region,
forest_area_sqkm AS f_area_2016,
percent_of_forest_in_land AS f_perc_area_2016
FROM forestation
WHERE year=2016 AND country_name != 'World'
ORDER BY country_name) AS t_2016

INNER JOIN
(SELECT country_name, region,
forest_area_sqkm AS f_area_1990,
percent_of_forest_in_land AS f_perc_area_1990
FROM forestation
WHERE year=1990 AND country_name != 'World'
ORDER BY country_name) AS t_1990

ON t_2016.country_name=t_1990.country_name
```

```
AND t_2016.region=t_1990.region
WHERE (f_area_2016-f_area_1990) IS NOT NULL
ORDER BY  forest_percentage_change_from1990_to2016   DESC
```

***B PART***
***1st Query***
***(Table 3.1)***

```
SELECT *,
CAST(100*(f_area_2016-f_area_1990)/f_area_1990 AS DECIMAL (5,2)) AS
forest_percentage_change_from1990_to2016,
f_area_2016-f_area_1990 AS forest_area_change_from1990_to2016

FROM
(SELECT country_name, region,
forest_area_sqkm AS f_area_2016,
percent_of_forest_in_land AS f_perc_area_2016
FROM forestation
WHERE year=2016 AND country_name != 'World'
ORDER BY country_name) AS t_2016

INNER JOIN
(SELECT country_name, region,
forest_area_sqkm AS f_area_1990,
percent_of_forest_in_land AS f_perc_area_1990
FROM forestation
WHERE year=1990 AND country_name != 'World'
ORDER BY country_name) AS t_1990

ON t_2016.country_name=t_1990.country_name
AND t_2016.region=t_1990.region
ORDER BY forest_area_change_from1990_to2016 ASC
LIMIT 5;
```

***2nd Query***
***(Table 3.2)***

```
SELECT *,
CAST(100*(f_area_2016-f_area_1990)/f_area_1990 AS DECIMAL (5,2)) AS
forest_percentage_change_from1990_to2016,
f_area_2016-f_area_1990 AS forest_area_change_from1990_to2016

FROM
```

```
(SELECT country_name, region,
forest_area_sqkm AS f_area_2016,
percent_of_forest_in_land AS f_perc_area_2016
FROM forestation
WHERE year=2016 AND country_name != 'World'
ORDER BY country_name) AS t_2016

INNER JOIN
(SELECT country_name, region,
forest_area_sqkm AS f_area_1990,
percent_of_forest_in_land AS f_perc_area_1990
FROM forestation
WHERE year=1990 AND country_name != 'World'
ORDER BY country_name) AS t_1990

ON t_2016.country_name=t_1990.country_name
AND t_2016.region=t_1990.region
ORDER BY forest_percentage_change_from1990_to2016 ASC
LIMIT 5;
```

***C PART***

***1st Query***

***(Table 3.3)***

```
WITH quart_table AS
(SELECT country_name, region,
CAST(percent_of_forest_in_land AS DECIMAL(5,2)),
CASE WHEN percent_of_forest_in_land>75.0 THEN '4th quartile'
WHEN percent_of_forest_in_land>50.0 THEN '3rd quartile'
WHEN percent_of_forest_in_land>25.0 THEN '2nd quartile'
ELSE '1st quartile' END AS quartiles
FROM forestation
WHERE year=2016 AND country_name != 'World' AND percent_of_forest_in_land IS NOT
NULL
ORDER BY percent_of_forest_in_land DESC)

SELECT COUNT(*) quartiles_countries_count_2016, quart_table.quartiles
FROM quart_table
GROUP BY quart_table.quartiles
ORDER BY quartiles_countries_count_2016
```

***2nd Query***

***(Table 3.4)***

```
WITH table_quart_countries2016 AS
(SELECT country_name, region,
```

```
CAST(percent_of_forest_in_land AS DECIMAL(5,2)) AS
percentage_ofland_designated_asforest_2016,
CASE WHEN percent_of_forest_in_land>75.0 THEN '4th quartile'
WHEN percent_of_forest_in_land>50.0 THEN '3rd quartile'
WHEN percent_of_forest_in_land>25.0 THEN '2nd quartile'
ELSE '1st quartile' END AS quartiles
FROM forestation
WHERE year=2016
AND country_name != 'World'
AND percent_of_forest_in_land IS NOT NULL
ORDER BY percent_of_forest_in_land DESC)

SELECT country_name, region, percentage_ofland_designated_asforest_2016
FROM table_quart_countries2016
WHERE quartiles='4th quartile'
```

***3rd Query***
***(Question 3e, from Part 3 - Country-Level Detail instructions)***

```
WITH countries_above_us AS
(SELECT country_name, region,
CAST(percent_of_forest_in_land AS DECIMAL(5,2)) AS
percentage_ofland_designated_asforest_2016
FROM forestation
WHERE year=2016 AND country_name != 'World' AND percent_of_forest_in_land IS NOT
NULL )

SELECT COUNT(*)
number_ofcountries_perc_forest_bigger_than_USA_instructions_3e_question
FROM countries_above_us
WHERE percentage_ofland_designated_asforest_2016>33.93
```

## *Recommendations section Queries*

***1st Query - table 4.1 (2nd Question)***

```
WITH quart_table AS
(SELECT country_name, region,
CAST(percent_of_forest_in_land AS DECIMAL(5,2)),
CASE WHEN percent_of_forest_in_land>75.0 THEN '4th quartile'
WHEN percent_of_forest_in_land>50.0 THEN '3rd quartile'
WHEN percent_of_forest_in_land>25.0 THEN '2nd quartile'
ELSE '1st quartile' END AS quartiles
FROM forestation
WHERE year=2016 AND country_name != 'World' AND percent_of_forest_in_land IS NOT
NULL
ORDER BY percent_of_forest_in_land DESC)
```

```
SELECT COUNT(*) quartiles_countries_count_2016, quart_table.quartiles, quart_table.region
FROM quart_table
GROUP BY quart_table.quartiles, quart_table.region
ORDER BY quartiles_countries_count_2016 DESC
LIMIT 5;
```

***2nd Query - table 4.2 (2nd Question)***

```
WITH quart_table AS
(SELECT country_name, region, income_group,
CAST(percent_of_forest_in_land AS DECIMAL(5,2)),
CASE WHEN percent_of_forest_in_land>75.0 THEN '4th quartile'
WHEN percent_of_forest_in_land>50.0 THEN '3rd quartile'
WHEN percent_of_forest_in_land>25.0 THEN '2nd quartile'
ELSE '1st quartile' END AS quartiles
FROM forestation
WHERE year=2016 AND country_name != 'World' AND percent_of_forest_in_land IS NOT
NULL
ORDER BY percent_of_forest_in_land DESC)

SELECT COUNT(*) quartiles_countries_count_2016, quart_table.quartiles, quart_table.region,
quart_table.income_group
FROM quart_table
GROUP BY quart_table.quartiles, quart_table.region, quart_table.income_group
ORDER BY quartiles_countries_count_2016 DESC
LIMIT 4;
```