

Report

Global Deforestation, 1990 to 2016 on behalf of ForestQuery.

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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.

As part of the data analysis team, our job is to use SQL to bring these tables together and to query them and find areas of concern as well as areas that present an opportunity to learn from successes. The insights I got are itemised below.

1. GLOBAL SITUATION

According to the World Bank, the total forest area of the world was 41,282,694.9 square kilometres in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 square kilometres, resulting in a loss of 1,324,449 square kilometres or 3.21% of the total forest area. The forest area lost over this period is slightly more than the entire land area of Peru listed for the year 2016 (which is 1,279,999.9891 square kilometres).

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 | DIFFERENCE |
|----------------------------|------------------------|------------------------|------------|
| Latin America & Caribbean | 51.03 | 46.16 | -4.87 |
| Europe & Central Asia | 37.28 | 38.04 | 0.76 |
| North America | 35.65 | 36.04 | 0.39 |
| World | 32.42 | 31.38 | -1.05 |
| Sub-Saharan Africa | 30.67 | 28.79 | -1.89 |
| East Asia & Pacific | 25.78 | 26.36 | 0.58 |
| South Asia | 16.51 | 17.51 | 1.00 |
| Middle East & North Africa | 1.78 | 2.07 | 0.29 |

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 increased in forest area over this period. However, the drop in forest area in the two 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

| country name | region | forest_area_1990 | forest_area_2016 | difference |
|---------------|---------------------|------------------|------------------|------------|
| China | East Asia & Pacific | 1,571,406 | 2,098,635 | 527,229 |
| United States | North America | 3,024,500 | 3,103,700 | 79,200 |

| Country name | region | forest_area_1990 | forest_area_2016 | difference | % diff |
|--------------|-----------------------|------------------|------------------|------------|--------|
| Iceland | Europe & Central Asia | 161 | 505 | 344 | 214 |

There is one particularly bright spot in the data at the country level, China. This country increased in forest area from 1990 to 2016 by 527229 square kilometres. 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 square kilometres, 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 214 % 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 kilometre decrease in forest area from 1990 to 2016. The following 3 countries had the largest decrease in forest area over the period under consideration:

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

| Country name | Region | Forest_area_1990 | Forest_area_2016 | Difference |
|--------------|---------------------------|------------------|------------------|------------|
| World | World | 41,282,695 | 39,958,246 | 1,324,449 |
| Brazil | Latin America & Caribbean | 5,467,050 | 4,925,540 | 541,510 |
| Indonesia | East Asia & Pacific | 1,185,450 | 903,256 | 282,194 |
| Myanmar | East Asia & Pacific | 392,180 | 284,946 | 107,234 |
| Nigeria | Sub-Saharan Africa | 172,340 | 65,834 | 106,506 |

The second method to consider which countries are of concern is to analyse the data by percent decrease.

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

| Country name | Region | Forest_area_1990 | Forest_area_2016 | Difference | % Diff |
|--------------|---------------------------|------------------|------------------|------------|--------|
| Togo | Sub-Saharan Africa | 6,850 | 1,682 | -5,168 | -75 |
| Nigeria | Sub-Saharan Africa | 172,340 | 65,834 | -106,506 | -62 |
| Uganda | Sub-Saharan Africa | 47,510 | 19,418 | -28,092 | -59 |
| Mauritania | Sub-Saharan Africa | 4,150 | 2,210 | -1,940 | -47 |
| Honduras | Latin America & Caribbean | 81,360 | 44,720 | -36,640 | -45 |

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 and 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 kilometre 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 |
|----------|---------------------|
| 0-25% | 85 |
| 25-50% | 72 |
| 50-75% | 38 |
| 75-100% | 9 |

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

There were Nine 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 |

4. RECOMMENDATIONS

These are my recommendations based on the above insights.

- **Global Efforts:** Given the worldwide decline in forest area by 3.21%, it is crucial for all countries to collectively address deforestation. International cooperation and joint efforts are essential to combat this environmental challenge on a global scale. Forest conservation initiatives, reforestation projects, and sustainable land management practices should be promoted and supported by countries worldwide.
- **Latin America and Caribbean Model:** Latin America and Caribbean regions have demonstrated impressive forestation growth between 46.16% to 51.3%. Other regions can learn from their successful strategies and practices to improve forestation efforts. Knowledge-sharing and collaboration between regions can lead to positive outcomes and accelerate reforestation initiatives.
- **Urgent Action for Brazil, Indonesia, and Myanmar:** Brazil, Indonesia, and Myanmar are facing significant forest area decreases, requiring urgent attention and intervention. Collaborative efforts between governments, NGOs, and international organizations are crucial to address the underlying causes of deforestation in these countries and implement effective conservation measures.
- **Support for 4th Quartile Countries:** Countries in the 4th Quartile (75%-100%) that demonstrated a strong commitment to growing their forested areas should be recognized and encouraged. They can serve as role models for other nations and may benefit from international support and funding to continue their successful forestation efforts.

- **Capacity Building for 1st Quartile Countries:** Approximately 85 countries in the 1st Quartile (0-25%) need to enhance their forestation efforts. These countries may lack resources or face specific challenges in promoting reforestation. International support, capacity-building programs, and knowledge transfer can help them improve forest management practices and boost forestation initiatives.
- **Nigeria's Urgent Intervention:** Nigeria's prominence as the only country ranking in the top 5 for both absolute square kilometre decrease and percent decrease in forest area demands immediate attention. A comprehensive approach that addresses deforestation drivers, strengthens forest protection measures, and promotes sustainable land use is essential to reverse this trend.
- **Data-Driven Policies:** Governments and organizations should utilize data analysis to inform policy decisions related to deforestation. Regular monitoring and analysis of forest area changes can identify emerging trends, areas of concern, and successful approaches. Data transparency and sharing can facilitate evidence-based policymaking and foster accountability.
- **Public Awareness and Education:** Increasing public awareness about the consequences of deforestation and the importance of forest conservation is crucial. Educational campaigns, community engagement, and environmental education programs can empower citizens to participate in forest protection efforts and support sustainable practices.
- **Public-Private Partnerships:** Collaborations between governments, private sectors, and non-profit organizations can amplify the impact of forestation initiatives. Public-private partnerships can mobilize resources, expertise, and innovation to address deforestation challenges and promote sustainable land management.

In conclusion, addressing the decline in forest areas requires a multi-faceted and collaborative approach. With concerted efforts, collective action, and sustainable practices, we can work towards mitigating deforestation, preserving biodiversity, and safeguarding the environment for future generations.

5. APPENDIX: SQL Queries Used

The view "forestation" combines data from the tables "land_area," "forest_area," and "regions" to provide information about forest areas and related details for different countries and years. This view allows for easier access and querying of forestation data across these tables.

CREATE VIEW forestation AS

```
SELECT
    fa.country_code,
    fa.country_name,
    fa.year,
    fa.forest_area_sqkm,
    r.region,
    r.income_group,
    la.total_area_sq_mi,
    (la.total_area_sq_mi) * 2.59 AS total_area_sqkm,
    ROUND((forest_area_sqkm / total_area_sq_mi)::numeric * (100.0 / 2.59), 2) AS
percent_of_forest_to_land_area
FROM land_area la
JOIN forest_area fa
ON la.year = fa.year AND la.country_code = fa.country_code
JOIN regions r
ON r.country_code = la.country_code;
```

-- GLOBAL SITUATION-1990:

This query retrieves the forest area in square kilometres for the "World" region in the year 1990.

```
SELECT forest_area_sqkm
FROM forestation
WHERE year = 1990 AND region = 'World';
```

--GLOBAL SITUATION-2016

This query retrieves the forest area in square kilometres for the "World" region in the year 2016.

```
SELECT forest_area_sqkm
FROM forestation
WHERE year = 2016 AND region = 'World';
```

--GLOBAL SITUATION_DIFFERENCE:

This query calculates the difference in forest area (in square kilometres) between the years 1990 and 2016 for the "World" region. It uses Common Table Expressions (CTEs) to first get the forest area values for each year and then calculates the loss (negative value) or gain (positive value) in forest area.

```
WITH fa_2016 AS (
    SELECT forest_area_sqkm AS fa_sqkm_2016, year
    FROM forestation
    WHERE year = 2016 AND region = 'World'
), fa_1990 AS (
    SELECT forest_area_sqkm AS fa_sqkm_1990, year
    FROM forestation
    WHERE year = 1990 AND region = 'World'
), fa_diff AS (
    SELECT fa_sqkm_2016, fa_sqkm_1990, fa_sqkm_1990 - fa_sqkm_2016 AS ta_loss_1990_2016
    FROM fa_2016, fa_1990
)
SELECT fa_sqkm_2016, fa_sqkm_1990, ta_loss_1990_2016
FROM fa_diff;
```

----GLOBAL SITUATION%LOSS

The provided query calculates the percentage loss in forest area between the years 1990 and 2016 for the "World" region. It uses Common Table Expressions (CTEs) to first get the forest area values for each year and then calculates the percentage loss based on the difference in forest area.

```
WITH fa_2016 AS (  
    SELECT forest_area_sqkm AS fa_sqkm_2016, year  
    FROM forestation  
    WHERE year = 2016 AND region = 'World'  
) , fa_1990 AS (  
    SELECT forest_area_sqkm AS fa_sqkm_1990, year  
    FROM forestation  
    WHERE year = 1990 AND region = 'World'  
) , fa_percent_Diff AS (  
    SELECT  
        fa_sqkm_2016,  
        fa_sqkm_1990,  
        fa_sqkm_2016 - fa_sqkm_1990 AS ta_loss_1990_2016,  
        (fa_sqkm_1990 - fa_sqkm_2016) / fa_sqkm_1990 * 100 AS pctg_fa_loss_1990_2016  
    FROM fa_2016, fa_1990  
)  
  
SELECT fa_sqkm_2016, fa_sqkm_1990, ROUND(pctg_fa_loss_1990_2016::NUMERIC, 2) AS  
pctg_fa_loss_1990_2016  
  
FROM fa_percent_Diff;
```

--GLOBAL SITUATION-PERU

```
SELECT country_name, total_area_sqkm  
FROM forestation  
WHERE total_area_sqkm < 1324449  
ORDER BY 2 DESC
```

LIMIT 1;

The result of this query will show the country name and its total area in square kilometres for the country with the largest total area that is less than 1,324,449 square kilometres. This will provide information on the country that has a total area roughly equivalent to the forest area lost globally between 1990 and 2016.

----REGIONAL OUTLOOK-2016

```
SELECT region, SUM(forest_area_sqkm)*100.0/SUM(total_area_sqkm) AS percent_forest_land_area
FROM forestation
WHERE year = 2016
GROUP BY region
ORDER BY 2;
```

The result of this query will show each region's name and the corresponding percentage of forested land area in that region for the year 2016. The regions will be listed in ascending order based on the percentage of forested land area, indicating which regions have the highest percentage of forested land area

----REGIONAL OUTLOOK-1990

```
SELECT region, SUM(forest_area_sqkm)*100.0/SUM(total_area_sqkm) AS percent_forest_land_area
FROM forestation
WHERE year = 1990
GROUP BY region
ORDER BY 2;
```

The result of this query will display each region's name and the corresponding percentage of forested land area in that region for the year 1990. The regions will be listed in ascending order based on the percentage of forested land area, indicating which regions had the highest percentage of forested land area in 1990.

-----REGIONAL OUTLOOK_TABLE_USED_IN_ANSWERING_QUESTIONS

The provided query calculates and compares the percentage of forested land area in different regions for both the years 1990 and 2016. It does this by using common table expressions (CTEs) to compute the percentage of forested land area for each region in both years and then joins the results to compare the differences between the two years.

WITH T1 AS (

```

SELECT region, SUM(forest_area_sqkm)*100.0/SUM(total_area_sqkm) AS
percent_forest_land_area_1990
FROM forestation
WHERE year = 1990
GROUP BY region
),
T2 AS (
SELECT region, SUM(forest_area_sqkm)*100.0/SUM(total_area_sqkm) AS
percent_forest_land_area_2016
FROM forestation
WHERE year = 2016
GROUP BY region
)
SELECT region,
ROUND(percent_forest_land_area_1990::NUMERIC, 2) AS forest_percentage_1990,
ROUND(percent_forest_land_area_2016::NUMERIC, 2) AS forest_percentage_2016,
ROUND((percent_forest_land_area_2016 - percent_forest_land_area_1990)::NUMERIC, 2) AS
difference
FROM T1
JOIN T2 ON T1.region = T2.region
GROUP BY 1, 2, 3, 4
ORDER BY 2 DESC;

```

----LARGEST CONCERNS_QUESTIONS

The provided query calculates the forest area for the year 1990 and 2016 for each country and region. It then computes the difference in forest area between these two years for each country and region and presents the top 5 countries with the largest decrease in forest area over this period. The query uses common table expressions (CTEs) to organize the data and join the results.

```

WITH T1 AS (

SELECT forest_area_sqkm AS forest_a_2016, country_name AS cn, region AS reg

FROM forestation

WHERE year = 2016 AND forest_area_sqkm IS NOT NULL

),

T2 AS (

SELECT forest_area_sqkm AS forest_a_1990, country_name, region

FROM forestation

WHERE year = 1990 AND forest_area_sqkm IS NOT NULL

```

```

)

SELECT country_name,
       region,
       ROUND(forest_a_1990::NUMERIC, 0) AS forest_area_1990,
       ROUND(forest_a_2016::NUMERIC, 0) AS forest_area_2016,
       ROUND((forest_a_1990 - forest_a_2016)::NUMERIC, 0) AS difference
FROM T1

JOIN T2 ON T1.reg = T2.region AND T1.cn = T2.country_name

GROUP BY 1, 2, t2.forest_a_1990, t1.forest_a_2016

ORDER BY 5 DESC

LIMIT 5;

```

----REGIONAL OUTLOOK-CHINA AND USA

The provided query calculates the forest area for the year 1990 and 2016 for each country and region. It then computes the difference in forest area between these two years for each country and region and presents the top 2 countries with the largest decrease in forest area over this period. The query uses common table expressions (CTEs) to organize the data and join the results.

```

WITH T1 AS (

    SELECT forest_area_sqkm AS forest_a_2016, country_name AS cn, region AS reg

    FROM forestation

    WHERE year = 2016 AND forest_area_sqkm IS NOT NULL

),

T2 AS (

    SELECT forest_area_sqkm AS forest_a_1990, country_name, region

    FROM forestation

    WHERE year = 1990 AND forest_area_sqkm IS NOT NULL

)

SELECT country_name,

```

```

        region,

        ROUND(forest_a_1990::NUMERIC, 0) AS forest_area_1990,

        ROUND(forest_a_2016::NUMERIC, 0) AS forest_area_2016,

        ROUND((forest_a_1990 - forest_a_2016)::NUMERIC, 0) AS difference

FROM T1

JOIN T2 ON T1.reg = T2.region AND T1.cn = T2.country_name

GROUP BY 1, 2, t2.forest_a_1990, t1.forest_a_2016

ORDER BY 5 DESC

LIMIT 2;

```

---REGIONAL OUTLOOK-ICELAND

The provided query calculates the forest area for the year 1990 and 2016 for each country and region. It then computes the difference and percentage change in forest area between these two years for each country and region and presents the country with the largest percentage decrease in forest area over this period. The query uses common table expressions (CTEs) to organize the data and join the results.

```

WITH T1 AS (

    SELECT forest_area_sqkm AS forest_a_2016, country_name AS cn, region AS reg

    FROM forestation

    WHERE year = 2016 AND forest_area_sqkm IS NOT NULL

),

T2 AS (

    SELECT forest_area_sqkm AS forest_a_1990, country_name, region

    FROM forestation

    WHERE year = 1990 AND forest_area_sqkm IS NOT NULL

)

SELECT country_name,

        region,

        ROUND(forest_a_1990::NUMERIC, 0) AS forest_area_1990,

```

```

ROUND(forest_a_2016::NUMERIC, 0) AS forest_area_2016,
ROUND((forest_a_2016 - forest_a_1990)::NUMERIC, 0) AS difference,
ROUND(((forest_a_2016 - forest_a_1990) * 100 / forest_a_1990)::NUMERIC, 0) AS per_diff
FROM T1
JOIN T2 ON T1.reg = T2.region AND T1.cn = T2.country_name
GROUP BY 1, 2, t2.forest_a_1990, t1.forest_a_2016
ORDER BY 6 DESC
LIMIT 1;

```

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

The provided query calculates the forest area for the year 1990 and 2016 for each country and region. It then computes the difference and percentage change in forest area between these two years for each country and region and presents the top 5 countries with the largest percentage decrease in forest area over this period. The query uses common table expressions (CTEs) to organize the data and join the results.

```

WITH T1 AS (
    SELECT forest_area_sqkm AS forest_a_2016, country_name AS cn, region AS reg
    FROM forestation
    WHERE year = 2016 AND forest_area_sqkm IS NOT NULL
),
T2 AS (
    SELECT forest_area_sqkm AS forest_a_1990, country_name, region
    FROM forestation
    WHERE year = 1990 AND forest_area_sqkm IS NOT NULL
)
SELECT country_name,
       region,
       ROUND(forest_a_1990::NUMERIC, 0) AS forest_area_1990,

```

```

ROUND(forest_a_2016::NUMERIC, 0) AS forest_area_2016,
ROUND((forest_a_2016 - forest_a_1990)::NUMERIC, 0) AS difference,
ROUND(((forest_a_2016 - forest_a_1990) * 100 / forest_a_1990)::NUMERIC, 0) AS per_diff
FROM T1
JOIN T2 ON T1.reg = T2.region AND T1.cn = T2.country_name
GROUP BY 1, 2, t2.forest_a_1990, t1.forest_a_2016
ORDER BY 6 DESC
LIMIT 5;

```

----QUARTILE QUESTION

The provided query calculates the number of countries falling into different quartiles based on their percentage of forest to land area for the year 2016. The quartiles are categorized as follows:

75%-100%: Countries with 75% to 100% forest to land area percentage.

50%-75%: Countries with 50% to 75% forest to land area percentage.

25%-50%: Countries with 25% to 50% forest to land area percentage.

0-25%: Countries with 0% to 25% forest to land area percentage.

WITH T1 AS (

```
SELECT country_name, percent_of_forest_to_land_area,
```

```
CASE
```

```
  WHEN f.percent_of_forest_to_land_area >= 75 THEN '75%-100%'
```

```
  WHEN f.percent_of_forest_to_land_area >= 50 THEN '50%-75%'
```

```
  WHEN f.percent_of_forest_to_land_area >= 25 THEN '25%-50%'
```

```
  ELSE '0-25%'
```

```
END AS quartiles
```

```
FROM forestation f
```

```
WHERE year = 2016 AND f.percent_of_forest_to_land_area IS NOT NULL
```



```
    AND country_name != 'World'
)

SELECT quartiles, COUNT(*) AS no_of_countries
FROM T1
GROUP BY quartiles
ORDER BY 1;
```

---Top Quartile Countries, 2016:

The provided query retrieves data from the forestation table for countries with forest to land area percentage between 75 and 100 for the year 2016. The query groups the results by country_name, region, and percent_of_forest_to_land_area, and then sorts the results in descending order based on the percent_of_forest_to_land_area.

```
SELECT country_name, region, percent_of_forest_to_land_area
FROM forestation
WHERE percent_of_forest_to_land_area BETWEEN 75 AND 100 AND year = 2016
GROUP BY country_name, region, percent_of_forest_to_land_area
ORDER BY percent_of_forest_to_land_area DESC;
```