# 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 41282694.90 $km^2$ in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.90 $km^2$, a loss of 1324449.00 $km^2$, 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 1279999.99 $km^2$).

## 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.

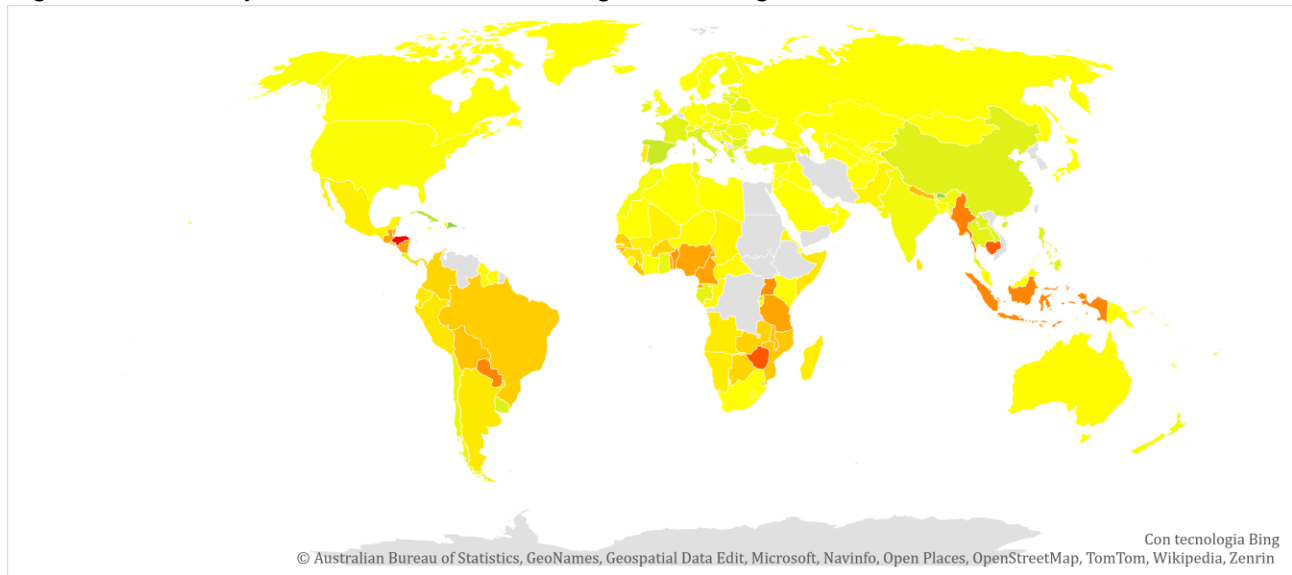Figure 2.1: Country Details Forest Area Change Percentage, 1990 & 2016:



Table 2.1: Percent Forest Area by Region, 1990 & 2016:

| Region | 1990 Forest In % | 2016 Forest In % | Forest Area Change In % |
|---|---|---|---|
| Latin America & Caribbean | 51.03 | 46.16 | -4.87 |
| Europe & Central Asia | 37.27 | 38.06 | 0.79 |
| North America | 35.65 | 36.04 | 0.39 |
| World | 32.42 | 31.38 | -1.04 |
| Sub-Saharan Africa | 32.19 | 27.56 | -4.63 |
| East Asia & Pacific | 25.77 | 26.36 | 0.59 |
| 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 (32.19% to 27.56%). 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 $527229.06\ km^2$. 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 $79200.00\ km^2$., much lower than the figure for China.

China and Russian Federation 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 68% from 1990 to 2016.

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

| Region | Country | Total Area 2016 In $km^2$ | Forest Area Change In $km^2$ |
|---|---|---|---|
| East Asia & Pacific | China | 9388210.01 | 527229.06 |
| North America | United States | 9147419.99 | 79200.00 |
| South Asia | India | 2973190.01 | 69213.98 |
| Europe & Central Asia | Russian Federation | 16376870.00 | 59395.00 |
| East Asia & Pacific | Vietnam | 310070.01 | 55390.00 |

Table 3.2: Top 5 Increase in Forest Area percentage by Country, 1990 & 2016:

| Region | Country | Total Area 2016 In $km^2$ | Forest Area Change In % |
|---|---|---|---|
| Europe & Central Asia | Iceland | 100249.99 | 68 |
| East Asia & Pacific | French Polynesia | 3660.01 | 65 |
| Middle East & North Africa | Bahrain | 778.01 | 64 |
| Latin America & Caribbean | Uruguay | 175020.00 | 57 |
| Middle East & North Africa | Kuwait | 17820.00 | 45 |

## 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 3.3: Top 3 Amount Decrease in Forest Area by Country, 1990 & 2016:

| Region | Country | Total Area 2016 In $km^2$ | Absolute Forest Area Change |
|---|---|---|---|
| Latin America & Caribbean | Brazil | 8358140.00 | 541510.00 |
| East Asia & Pacific | Indonesia | 1811570.01 | 282193.98 |
| East Asia & Pacific | Myanmar | 653080.00 | 107234.00 |

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

Table 3.4: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

| Region | Country | Total Area 2016 In $km^2$ | Pct Forest Area Change |
|---|---|---|---|
| Sub-Saharan Africa | Togo | 54390.00 | 75 |
| Sub-Saharan Africa | Nigeria | 910770.00 | 62 |
| Sub-Saharan Africa | Uganda | 200520.00 | 59 |
| Sub-Saharan Africa | Mauritania | 1030700.01 | 47 |
| Latin America & Caribbean | Honduras | 111889.99 | 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 & 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 3.5: 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 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 3.6: Top Quartile Countries, 2016:

| Region | Country | Pct Designated as Forest |
|--------|---------|--------------------------|
| Latin America & Caribbean | Suriname | 98.26 |
| East Asia & Pacific | Micronesia, Fed. Sts. | 91.86 |
| Sub-Saharan Africa | Gabon | 90.04 |
| Sub-Saharan Africa | Seychelles | 88.41 |
| East Asia & Pacific | Palau | 87.61 |
| East Asia & Pacific | American Samoa | 87.50 |
| Latin America & Caribbean | Guyana | 83.90 |
| East Asia & Pacific | Lao PDR | 82.11 |
| East Asia & Pacific | Solomon Islands | 77.86 |

# 4. RECOMMENDATIONS

*Write out a set of recommendations as an analyst on the ForestQuery team.*

- *What have you learned from the World Bank data?*

*From the analysis conducted, it is evident that countries that have driven capitalism, such as the United States and China, have taken some remedial actions during the analyzed period by increasing their forestation percentages compared to 1990. It is also clear that the countries bearing the brunt of the current production system are those that are less economically developed and more affected by desertification. It would be intriguing to analyze a broader spectrum of data, spanning at least a century, to understand the impact of the current production system on resources such as forests. In the final analysis, the overall picture remains negative at a global level. The major powers have indeed intervened, but in my opinion, if we look back to data from the beginning of the century, the balance will likely not be positive.*

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

*In continuity with the previous answer, I believe that attention should be focused on former colonial countries in the Sub-Saharan Africa region. Nigeria is a striking example, being a territory rich in natural and mineral resources but economically poor and politically unstable. Despite the encouraging results regarding China and the United States, it is important to highlight that China plays a significant role in Nigeria, having recently promoted multiple economic initiatives and investments in that country. What does not emerge from the data, but is part of a broader context, is how certain countries tend to export their "dirt" beyond their own borders, to the detriment of developing nations. In conclusion, the global data on this issue (which is part of a much larger context) sends a clear message: the entire world is at a significant loss. It does not matter if this or that country shows a positive result over a decade by exploiting the resources of another country for production and profit; we are all on the same planet.*

# 5. APPENDIX: SQL Queries Used

```
CREATE OR REPLACE VIEW forestation AS
WITH t0 AS (
    SELECT
        r.country_name,
        r.country_code,
        r.region,
        r.income_group,
        la.year,
        la.total_area_sq_mi::numeric * 2.59 AS total_area_sq_km,
        fa.forest_area_sqkm AS forest_area_sq_km
    FROM
        regions r
```

```sql
    JOIN
        land_area la ON r.country_code = la.country_code
        AND COALESCE(la.total_area_sq_mi, 0::double precision) <> 0::double
precision
    JOIN
        forest_area fa ON la.country_code = fa.country_code
        AND la.year = fa.year
        AND fa.forest_area_sqkm IS NOT NULL
)
SELECT
    country_name,
    country_code,
    region,
    income_group,
    year,
    total_area_sq_km,
    forest_area_sq_km,
    forest_area_sq_km / total_area_sq_km::double precision * 100::double
precision AS perc_land_designed_as_forest_sq_km
FROM
    t0;
```

```sql
-- 1. GLOBAL SITUATION
-- G_Q1 - According to the World Bank, what was the total forest area of the
world in 1990?
-- G_Q2 - As of 2016, the most recent year for which data was available, what had
that number fallen to?
-- G_Q3 - As of 2016, the most recent year for which data was available, what was
the loss in absolute terms?
-- G_Q4 - As of 2016, the most recent year for which data was available, what was
the loss in percentage terms?
-- G_Q5 - The forest area lost over this time period is slightly more than the
entire land area of which country listed for the year 2016?
-- G_Q6 - What was the entire land area of that country listed for the year 2016?

WITH t0 AS (
    SELECT
        "year",
        ROUND(SUM(forest_area_sq_km::numeric), 2) AS sum_forest_area_sq_km
    FROM
        forestation f
    WHERE
        "year" IN (1990, 2016)
```

```sql
        AND country_name = 'World'
    GROUP BY
        "year"
),
t1 AS (
    SELECT
        MAX(CASE WHEN "year" = 1990 THEN sum_forest_area_sq_km END) AS
sum_forest_area_sq_km_1990,
        MAX(CASE WHEN "year" = 2016 THEN sum_forest_area_sq_km END) AS
sum_forest_area_sq_km_2016
    FROM
        t0
),
t2 AS (
    SELECT
        sum_forest_area_sq_km_1990,
        sum_forest_area_sq_km_2016,
        sum_forest_area_sq_km_1990 - sum_forest_area_sq_km_2016 AS
forest_area_lost_1990_to_2016_sq_km,
        ROUND(((sum_forest_area_sq_km_1990 -
sum_forest_area_sq_km_2016)/sum_forest_area_sq_km_1990*100)::numeric, 2) AS
forest_area_lost_1990_to_2016_perc
    FROM
        t1
),
t3 AS (
    SELECT
        sum_forest_area_sq_km_1990,
        sum_forest_area_sq_km_2016,
        forest_area_lost_1990_to_2016_sq_km,
        forest_area_lost_1990_to_2016_perc,
        f2.country_name AS country_eq_name,
        ROUND(f2.total_area_sq_km, 2) AS country_eq_total_area_sq_km
    FROM
        t2
    JOIN
        forestation f2
    ON
        t2.forest_area_lost_1990_to_2016_sq_km >= f2.total_area_sq_km
        AND f2."year" = 2016
    ORDER BY
        f2.total_area_sq_km DESC
    LIMIT 1
)
SELECT
```

```sql
    sum_forest_area_sq_km_1990 AS G_Q1,
    sum_forest_area_sq_km_2016 AS G_Q2,
    forest_area_lost_1990_to_2016_sq_km AS G_Q3,
    forest_area_lost_1990_to_2016_perc AS G_Q4,
    country_eq_name AS G_Q5,
    country_eq_total_area_sq_km AS G_Q6
FROM
    t3;

-- 2. REGIONAL OUTLOOK
-- 2_Q1 - Figure 2.1: Country Details Forest Area Change Percentage, 1990 & 2016:
WITH t1 AS (
    SELECT
        f1.region,
        f1.country_name,
        ROUND((SUM(f1.forest_area_sq_km)/SUM(f1.total_area_sq_km)*100)::numeric,
2) AS forest_percentage_in_1990
    FROM
        forestation f1
    WHERE
        f1."year" = 1990
    GROUP BY
        f1.region, f1.country_name
),
t2 AS (
    SELECT
        f2.region,
        f2.country_name,
        ROUND((SUM(f2.forest_area_sq_km)/SUM(f2.total_area_sq_km)*100)::numeric,
2) AS forest_percentage_in_2016
    FROM
        forestation f2
    WHERE
        f2."year" = 2016
    GROUP BY
        f2.region, f2.country_name
)
SELECT
    t1.country_name,
    t2.forest_percentage_in_2016 - t1.forest_percentage_in_1990 AS
forest_area_change_in_perc
FROM
    t1
JOIN
    t2
```

```sql
ON
    t1.region = t2.region
    AND t1.country_name = t2.country_name
ORDER BY
    2 DESC;

-- 2_Q2 - Table 2.1: Percent Forest Area by Region, 1990 & 2016
WITH t1 AS (
    SELECT
        f1.region,
        ROUND((SUM(f1.forest_area_sq_km)/SUM(f1.total_area_sq_km)*100)::numeric,
2) AS forest_percentage_in_1990
    FROM
        forestation f1
    WHERE
        f1."year" = 1990
    GROUP BY
        f1.region
),
t2 AS (
    SELECT
        f2.region,
        ROUND((SUM(f2.forest_area_sq_km)/SUM(f2.total_area_sq_km)*100)::numeric,
2) AS forest_percentage_in_2016
    FROM
        forestation f2
    WHERE
        f2."year" = 2016
    GROUP BY
        f2.region
)
SELECT
    t1.region,
    t1.forest_percentage_in_1990,
    t2.forest_percentage_in_2016,
    t2.forest_percentage_in_2016 - t1.forest_percentage_in_1990 AS
forest_area_change_in_perc
FROM
    t1
JOIN
    t2
ON
    t1.region = t2.region
ORDER BY
    2 DESC, 3 DESC;
```

```sql
-- 3. COUNTRY-LEVEL DETAIL
-- 3.A. SUCCESS STORIES
-- 3_A_Q1 Top 5 Increase in Forest Area by Country, 1990 & 2016
WITH t1 AS (
    SELECT
        f1.region,
        f1.country_name,
        ROUND(SUM(f1.forest_area_sq_km::numeric), 2) AS forest_area_in_1990
    FROM
        forestation f1
    WHERE
        f1."year" = 1990
    GROUP BY
        f1.region, f1.country_name
),
t2 AS (
    SELECT
        f2.region,
        f2.country_name,
        ROUND(SUM(f2.total_area_sq_km), 2) AS total_area_sq_km_in_2016,
        ROUND(SUM(f2.forest_area_sq_km::numeric), 2) AS forest_area_in_2016
    FROM
        forestation f2
    WHERE
        f2."year" = 2016
    GROUP BY
        f2.region, f2.country_name
)
SELECT
    t1.region,
    t1.country_name,
    t2.total_area_sq_km_in_2016,
    t2.forest_area_in_2016 - t1.forest_area_in_1990 AS forest_area_change
FROM
    t1
JOIN
    t2
ON
    t1.region = t2.region
    AND t1.country_name = t2.country_name
WHERE
    t2.forest_area_in_2016 - t1.forest_area_in_1990 > 0
    AND t1.region <> 'World'
ORDER BY
```

```sql
    4 DESC
LIMIT 5;

-- 3_A_Q2 Top 5 Increase in Forest Area percentage by Country, 1990 & 2016
WITH t1 AS (
    SELECT
        f1.region,
        f1.country_name,
        ROUND(SUM(f1.forest_area_sq_km::numeric), 2) AS forest_area_in_1990
    FROM
        forestation f1
    WHERE
        f1."year" = 1990
    GROUP BY
        f1.region, f1.country_name
),
t2 AS (
    SELECT
        f2.region,
        f2.country_name,
        ROUND(SUM(f2.total_area_sq_km), 2) AS total_area_sq_km_in_2016,
        ROUND(SUM(f2.forest_area_sq_km::numeric), 2) AS forest_area_in_2016
    FROM
        forestation f2
    WHERE
        f2."year" = 2016
    GROUP BY
        f2.region, f2.country_name
)
SELECT
    t1.region,
    t1.country_name,
    t2.total_area_sq_km_in_2016,
    ROUND((1 - (t1.forest_area_in_1990 / t2.forest_area_in_2016)) * 100) AS
abs_forest_area_change
FROM
    t1
JOIN
    t2
ON
    t1.region = t2.region
    AND t1.country_name = t2.country_name
WHERE
    t2.forest_area_in_2016 > t1.forest_area_in_1990
    AND t1.region <> 'World'
```

```sql
ORDER BY
    4 DESC
LIMIT 5;

-- 3.B. LARGEST CONCERNS
-- 3_B_Q1 Top 5 Increase in Forest Area by Country, 1990 & 2016
WITH t1 AS (
    SELECT
        f1.region,
        f1.country_name,
        ROUND(SUM(f1.forest_area_sq_km::numeric), 2) AS forest_area_in_1990
    FROM
        forestation f1
    WHERE
        f1."year" = 1990
    GROUP BY
        f1.region, f1.country_name
),
t2 AS (
    SELECT
        f2.region,
        f2.country_name,
        ROUND(SUM(f2.total_area_sq_km), 2) AS total_area_sq_km_in_2016,
        ROUND(SUM(f2.forest_area_sq_km::numeric), 2) AS forest_area_in_2016
    FROM
        forestation f2
    WHERE
        f2."year" = 2016
    GROUP BY
        f2.region, f2.country_name
)
SELECT
    t1.region,
    t1.country_name,
    t2.total_area_sq_km_in_2016,
    ABS(t2.forest_area_in_2016 - t1.forest_area_in_1990) AS
abs_forest_area_change
FROM
    t1
JOIN
    t2
ON
    t1.region = t2.region
    AND t1.country_name = t2.country_name
WHERE
```

```sql
        t2.forest_area_in_2016 < t1.forest_area_in_1990
    AND t1.region <> 'World'
ORDER BY
    4 DESC
LIMIT 3;

-- 3_B_Q2 Top 5 Increase in Forest Area percentage by Country, 1990 & 2016
WITH t1 AS (
    SELECT
        f1.region,
        f1.country_name,
        ROUND(SUM(f1.forest_area_sq_km::numeric), 2) AS forest_area_in_1990
    FROM
        forestation f1
    WHERE
        f1."year" = 1990
    GROUP BY
        f1.region, f1.country_name
),
t2 AS (
    SELECT
        f2.region,
        f2.country_name,
        ROUND(SUM(f2.total_area_sq_km), 2) AS total_area_sq_km_in_2016,
        ROUND(SUM(f2.forest_area_sq_km::numeric), 2) AS forest_area_in_2016
    FROM
        forestation f2
    WHERE
        f2."year" = 2016
    GROUP BY
        f2.region, f2.country_name
)
SELECT
    t1.region,
    t1.country_name,
    t2.total_area_sq_km_in_2016,
    ROUND((1 - (t2.forest_area_in_2016 / t1.forest_area_in_1990)) * 100) AS
abs_forest_area_change
FROM
    t1
JOIN
    t2
ON
    t1.region = t2.region
    AND t1.country_name = t2.country_name
```

```sql
WHERE
    t2.forest_area_in_2016 < t1.forest_area_in_1990
    AND t1.region <> 'World'
ORDER BY
    4 DESC
LIMIT 5;

-- 3.C. QUARTILES
-- 3_C_Q1 Table 3.5: Count of Countries Grouped by Forestation Percent Quartiles,
2016
WITH t0 AS (
    SELECT
        country_name,
        region,
        perc_land_designed_as_forest_sq_km,
        CASE
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 75
AND 100 THEN 4
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 50
AND 75 THEN 3
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 25
AND 50 THEN 2
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 0
AND 25 THEN 1
        END AS quartile
    FROM
        forestation f
    WHERE
        f."year" = 2016
        AND f.country_name <> 'World'
        AND perc_land_designed_as_forest_sq_km IS NOT NULL
)
SELECT
    quartile,
    COUNT(*) AS number_of_countries
FROM
    t0
GROUP BY
    quartile
ORDER BY
    quartile ASC;

-- 3_C_Q2 Table 3.6: Top Quartile Countries, 2016
WITH t0 AS (
    SELECT
```

```
        country_name,
        region,
        perc_land_designed_as_forest_sq_km,
        CASE
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 75
AND 100 THEN 4
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 50
AND 75 THEN 3
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 25
AND 50 THEN 2
            WHEN ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) BETWEEN 0
AND 25 THEN 1
        END AS quartile
    FROM
        forestation f
    WHERE
        f."year" = 2016
        AND f.country_name <> 'World'
        AND perc_land_designed_as_forest_sq_km IS NOT NULL
)
SELECT
    region,
    country_name,
    ROUND(perc_land_designed_as_forest_sq_km::numeric, 2) AS
pct_designated_as_forest
FROM
    t0
WHERE
    quartile = 4
ORDER BY
    3 DESC;
```