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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** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9,** a loss of **1324449** or **3.20824258980244% ~ 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 **1279999.9891**).

2. **REGIONAL OUTLOOK**

In 2016, the percentage of the total land area of the world designated as forest was **31.3755709643095 ~ 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 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.

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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%.**

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** 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 sq km,** 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 **213.664588870028 % ~ 213.67%** 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 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:

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Country	Region	Absolute Forest Area Change
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282193.98
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

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C. QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

Quartile	Number of Countries
25-50%	72
75 - 100%	9
0-25%	85
50-75%	38

The largest number of countries in 2016 were found in the **0-25%** 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	98.25769397
Micronesia, Fed. Sts.	East Asia & Pacific	91.85723907
Gabon	Sub-Saharan Africa	90.03764187
Seychelles	Sub-Saharan Africa	88.41113674
Palau	East Asia & Pacific	87.60680855
American Samoa	East Asia & Pacific	87.5000875
Guyana	Latin America & Caribbean	83.90144891
Lao PDR	East Asia & Pacific	82.10823176
Solomon Islands	East Asia & Pacific	77.86351779

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5. RECOMMENDATIONS

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

- ***What have you learned from the World Bank data?***
  Based on my findings after analyzing the provided data, it can be seen that forestation rate is declining with about 3.21% between 1990 to 2016. The findings also highlight the world has lost an entire forest size area more than entire Peru land area as of 2016.

- ***Which countries should we focus on over others?***
  Again, based on my findings after analyzing the provided data, the area of concerns are mostly countries located in Sub-Saharan Africa Region. We see most of the countries in this region have considerably decrease in forestation between 1990 and 2016. The Countries that should be focus on are Togo, Nigeria, Uganda and Mauritania. We can study what China has done differently to increase its forestation as a means to remediate issue in Sub-Saharan Africa Region

Appendix: SQL queries used

Database SCHEMA

forest_area	land_area	regions
country_code	country_code	country_name
country_name	country_name	country_code
year	year	region
forest_area_sqkm	total_area_sq_mi	income_group

```
CREATE VIEW forestation AS
SELECT f.country_name  "Country Name",
    f.country_code  "Country Code",
    f.year,
    f.forest_area_sqkm  "Forest_Area",
    l.total_area_sq_mi "Area Sq_mi",
    l.total_area_sq_mi * 2.59 "Total Area_sqkm",
    r.region "Region",
    r.income_group "Income Group",
```

```
    100 * (f.forest_area_sqkm * 100 /(l.total_area_sq_mi * 259))  "Forest Percentage"
FROM forest_area f
JOIN land_area l
ON f.country_code = l.country_code
AND f.year = l.year
JOIN regions r
ON l.country_code = r.country_code;
```

```
/* GLOBAL SITUATION Question
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 SUM("Forest Area")
FROM forestation
WHERE year = 1990
AND "Region" = 'World';
```

```
/* GLOBAL SITUATION Question
What was the total forest area (in sq km) of the world in 2016?
Please keep in mind that the country record in the table is denoted as “World.”
*/
SELECT SUM("Forest_Area")
FROM forestation
WHERE year = 2016
AND "Region" = 'World';
```

```
/* GLOBAL SITUATION Question
What was the change (in sq km) in the forest area of the world from 1990 to 2016?
```

```
*/

SELECT (f1."Forest_Area" - f2."Forest_Area") AS "Forest_Area_Change"
FROM    forestation f1,
     forestation f2
WHERE
  f1.year = 1990
AND f1."Region" = 'World'
AND f2.year = 2016
AND f2."Region" = 'World';
```

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

SELECT (f1."Forest_Area" - f2."Forest_Area") * 100/f1."Forest_Area"
AS  "Forest_Percent_Change"
FROM    forestation f1,
     forestation f2
WHERE
  f1.year = 1990
AND f1."Region" = 'World'
AND f2.year = 2016
AND f2."Region" = 'World';


/* Output : 3.20824258980244 */
```

```
/*
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?
*/
```

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```
SELECT "Country Name", "Total_Area_Sqkm"
FROM forestation
WHERE "Year" = 2016 AND
ORDER BY "Total_Area_Sqkm" DESC;

OutPut : Peru with 1279999.9891
```

REGIONAL OUTLOOK

```
/* Create a table that shows the Regions and their percent forest area
(sum of forest area divided by sum of land area) in 1990 and 2016. (Note that 1 sq mi = 2.59 sq km) */

SELECT "Region", ROUND(CAST((forest_region_1990/region_1990) * 100 AS NUMERIC), 2)
    AS percent_forest_1990,
    ROUND(CAST((forest_region_2016/region_2016) * 100 AS NUMERIC), 2)
    AS percent_forest_2016

FROM(SELECT SUM(f1."Forest_Area") forest_region_1990,
          SUM(f1."Total Area_sqkm") region_1990,
          f1."Region",
          SUM(f2."Forest_Area") forest_region_2016,
          SUM(f2."Total Area_sqkm") region_2016

          FROM   forestation f1,
               forestation f2
          WHERE  f1.year = '1990'
          AND    f1."Country Name" NOT LIKE 'World'
          AND    f2.year = '2016'
          AND    f2."Country Name" NOT LIKE 'World'
```

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```
            AND f1."Region" = f2."Region"
            GROUP BY f1."Region") percent_region
ORDER BY percent_forest_1990 DESC;
/* What was the percent forest of the entire world in 2016? */
SELECT "Forest_Area" * 100/"Total Area_sqkm" AS "Percent_Forest_2016"
FROM forestation
WHERE year = 2016
AND "Country Name" = 'World';

-- 31.3755709643095
/* Which region had the HIGHEST percent forest in 2016 ROUND to 2 decimal places*/

SELECT "Region",
ROUND(CAST(forest_percent AS numeric), 2) AS percent
FROM
    (SELECT "Region", SUM("Forest_Area")* 100/SUM("Total Area_sqkm") AS forest_percent
    FROM forestation
    WHERE year = 2016
    GROUP BY "Region") sub
ORDER BY forest_percent DESC
LIMIT 5;
```

Region	percent
Latin America & Caribbean	46.16
Europe & Central Asia	38.04
North America	36.04
World	31.38
Sub-Saharan Africa	28.79

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```
/* Which region had the LOWEST percent forest in 2016 ROUND to 2 decimal places*/

SELECT "Region",
ROUND(CAST(forest_percent AS numeric), 2) AS percent
FROM
    (SELECT "Region", SUM("Forest_Area")* 100/SUM("Total Area_sqkm") AS forest_percent
    FROM forestation
    WHERE year = 2016
    GROUP BY "Region") sub
ORDER BY forest_percent
LIMIT 1;
```

Region	percent
Middle East & North Africa	2.07

```
/*What was the percent forest of the entire world in 1990?*/

SELECT "Forest_Area" * 100/"Total Area_sqkm" AS "Percent_Forest_1990"
FROM forestation
WHERE year = 1990
AND "Country Name" = 'World';
```

Percent_Forest_1990
32.4222035575689

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```sql
/*Which region had the HIGHEST percent forest in 1990 */
SELECT "Region",
ROUND(CAST(forest_percent AS numeric), 2) AS Percent
FROM
    (SELECT "Region", SUM("Forest_Area")* 100/SUM("Total Area_sqkm") AS forest_percent
    FROM forestation
    WHERE year = 1990
    GROUP BY "Region") sub
ORDER BY forest_percent DESC
LIMIT 1;
```

```sql
/*Which region had the LOWEST percent forest in 1990 */

SELECT "Region",
ROUND(CAST(forest_percent AS numeric), 2) AS Percent
FROM
    (SELECT "Region", SUM("Forest_Area")* 100/SUM("Total Area_sqkm") AS forest_percent
    FROM forestation
    WHERE year = 1990
    GROUP BY "Region") sub
ORDER BY forest_percent
LIMIT 1;
```

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```sql
/* 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
tab1 AS(SELECT "Region",
            "Country Name",
            "Forest_Area"
        FROM forestation
        WHERE year = 1990),

 tab2 AS
        (SELECT "Region",
            "Country Name",
            "Forest_Area"
        FROM forestation
        WHERE year = 2016)

SELECT tab1."Region",
        tab1."Country Name",
        tab1."Forest_Area" forest_1990,
        tab2."Forest_Area" forest_2016,
        ROUND(CAST((tab1."Forest_Area" - tab2."Forest_Area")AS numeric), 2) AS forest_area_difference,
        ROUND(CAST(((tab1."Forest_Area" - tab2."Forest_Area")*100/tab1."Forest_Area")AS numeric), 2)
AS decrease_percent

FROM tab1
JOIN tab2
ON tab1."Country Name" = tab2."Country Name"
WHERE tab2."Forest_Area" < tab1."Forest_Area"
AND tab1."Region" != 'World'
ORDER BY forest_area_difference DESC
LIMIT 5;
```

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```
SELECT f1.country_name country,
      (f1.forest_area_sqkm  - f2.forest_area_sqkm)AS forest_difference
FROM forest_area f1
JOIN forest_area f2
ON (f1.year = '2016' AND f2.year = '1990')
AND f1.country_name = f2.country_name
ORDER BY forest_difference DESC;

China -------- 527229.062
United States -- 79200
```

```
SELECT f1.country_name country,
      100.0 * (f1.forest_area_sqkm  - f2.forest_area_sqkm) / f2.forest_area_sqkm AS percent_difference
FROM forest_area f1
JOIN forest_area f2
ON (f1.year = '2016' AND f2.year = '1990')
AND f1.country_name = f2.country_name
ORDER BY percent_difference DESC;

Iceland --- 213.664588870028
/*Which 5 countries saw the largest percent decrease in forest
rea from 1990 to 2016? What was the percent change to 2?
decimal places for each?
*/
WITH
tab1 AS(SELECT "Region",
            "Country Name",
            "Forest_Area"
      FROM forestation
      WHERE year = 1990),

 tab2 AS
      (SELECT "Region",
            "Country Name",
            "Forest_Area"
      FROM forestation
      WHERE year = 2016)

SELECT tab1."Region",
      tab1."Country Name",
      tab1."Forest_Area" forest_1990,
      tab2."Forest_Area" forest_2016,
      ROUND(CAST((tab2."Forest_Area" - tab1."Forest_Area")AS numeric), 2) AS forest_area_difference,
```

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```
    ROUND(CAST(((tab2."Forest_Area" - tab1."Forest_Area")*100/tab1."Forest_Area")AS numeric), 2)
AS decrease_percent

FROM tab1
JOIN tab2
ON tab1."Country Name" = tab2."Country Name"
WHERE tab2."Forest_Area" < tab1."Forest_Area"
AND tab1."Region" != 'World'

ORDER BY decrease_percent DESC
LIMIT 5;
```

Region	Country Name	forest_1990	forest_2016	forest_area_difference	decrease_percent
Latin America & Caribbean	Brazil	5467050	4925540	541510	9.9
East Asia & Pacific	Indonesia	1185450	903256.0156	282193.98	23.8
East Asia & Pacific	Myanmar	392180	284945.9961	107234	27.34
Sub-Saharan Africa	Nigeria	172340	65833.99902	106506	61.8
Sub-Saharan Africa	Tanzania	559200	456880	102320	18.3

```
/*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
tab1 AS(SELECT "Region",
            "Country Name",
            "Forest_Area"
        FROM forestation
        WHERE year = 1990),

 tab2 AS
        (SELECT "Region",
            "Country Name",
            "Forest_Area"
        FROM forestation
        WHERE year = 2016)

SELECT tab1."Region",
        tab1."Country Name",
        tab1."Forest_Area" forest_1990,
```

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```
    tab2."Forest_Area" forest_2016,
    ROUND(CAST((tab1."Forest_Area" - tab2."Forest_Area")AS numeric), 2) AS forest_area_difference,
    ROUND(CAST(((tab1."Forest_Area" - tab2."Forest_Area")*100/tab1."Forest_Area")AS numeric), 2)
AS decrease_percent

FROM tab1
JOIN tab2
ON tab1."Country Name" = tab2."Country Name"
WHERE tab2."Forest_Area" < tab1."Forest_Area"
AND tab1."Region" != 'World'
ORDER BY decrease_percent DESC
LIMIT 5;
```

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

WITH tab1 AS
(SELECT *
FROM forestation
WHERE year = 2016
AND "Region" NOT LIKE 'World'
AND "Forest Percentage" IS NOT NULL),

tab2 AS
(SELECT *,
CASE
WHEN "Forest Percentage" >= 75 THEN '75 - 100%'
WHEN "Forest Percentage" > 50 AND "Forest Percentage" <= 75 THEN '50-75%'
WHEN "Forest Percentage" > 25 AND "Forest Percentage" <= 50 THEN '25-50%'
ELSE '0-25%'
END AS Quartile
FROM tab1)

SELECT Quartile , COUNT(*) AS "Number of Countries"
FROM tab2
GROUP BY Quartile;
```

quartile	Number of Countries
25-50%	72
75 - 100%	9
0-25%	85
50-75%	38

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```sql
/* List all of the countries that were in the 4th quartile (percent forest > 75%)
in 2016. */
SELECT "Country Name",
       "Region",
       "Forest Percentage"
FROM forestation
WHERE "Forest Percentage"> 75
AND "Forest Percentage" IS NOT NULL
AND year = 2016
ORDER BY "Forest Percentage" DESC;
```

```sql
/* How many countries had a percent forestation higher than the United States in
2016?*/
SELECT COUNT("Country Name")
FROM forestation
WHERE year = 2016
AND "Forest Percentage" >
        (SELECT "Forest Percentage"
        FROM forestation
        WHERE "Country Name" = 'United States'
        AND year = 2016);
```