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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 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 3.21 %.

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 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 46.14%, and the region with the lowest relative forestation was Middle East, 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 51.08%, and the region with the lowest relative forestation was Middle East, with 1.78 % forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51.08	46.14
Sub-Saharan Africa	32.19	27.56
World	32.42	31.38

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The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.08% to 46.14%) 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. 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, 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 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:

Country	Region	Absolute Forest Area Change
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282193
Myanmar	East Asian & Pacific	107234
Nigeria	Sub-Saharan Africa	106506.00
Tanzania	Sub-Saharan Africa	102320

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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	61.80
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 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
0-25%	85
25-50%	73
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the 0-25% quartile.

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

5. RECOMMENDATIONS

It is unfortunate that most of the percent forest decline happened in the Sub-Sahara Africa; these are smaller countries with smaller land area. The biggest lost in forest area was Brazil, Indonesia and Myanmar. A very surprising finding was that two of the world's largest polluters of Carbon (China and United States) saw an increase in forest area. It will be recommended for team to further investigate the reason for this improvement and what kind of green initiatives have led to this. For instance, what has led to Iceland's whopping 213.66% percent forest increase from 1990 to 2016.

Further, the team should focus on understanding the reason for a significant decline in percent forestation in the Sub-Saharan African countries especially Togo, Nigeria, Uganda and Mauritania. Nigeria for instance was on both the list for decline in forest area and percent forestation. Nigeria therefore will be a good candidate to implement any new policies or programs due to its smaller land area compared to a country like Brazil.

The team should look into reasons for loss of significant forestation in Brazil, Indonesia and Myanmar. Brazil especially saw the most significant decline in forestation – recent wild fires in the Amazon is probably a significant contributing factor to this observation.

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Lastly, although China and United States have done considerably well in improving forestation on their lands, there are still over 94 countries which have more percent forestation that the United States. It is recommended that the team looks at countries like Iceland and then expand their assessment to other 93 countries that sill doing reasonably well in preserving their natural habitat.

CODE

GLOBAL

a. 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 *
FROM forest_area
WHERE year = '1990' AND country_name = 'World'
```

Ans: 41282694.9

b. What was the total forest area (in sq km) of the world in 2016?
Please keep in mind that you can use the country record in the table is denoted as "World."

```
SELECT *
FROM forest_area
WHERE country_name = 'World' AND year = '2016'
```

Ans: 39958245.9

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

```
SELECT (t1.forest_area_sqkm - t2.forest_area_sqkm) change
FROM
(SELECT forest_area_sqkm
FROM forest_area
WHERE country_name = 'World' AND year = '1990') t1
,(SELECT forest_area_sqkm
FROM forest_area
WHERE country_name = 'World' AND year = '2016') t2
```

Ans: 1324449 sqkm

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

SELECT ((t1.forest_area_sqkm-t2.forest_area_sqkm)/t1.forest_area_sqkm)*100
percent_change
FROM
(SELECT forest_area_sqkm
FROM forest_area
WHERE country_name = 'World' AND year = '1990') t1
,(SELECT forest_area_sqkm
FROM forest_area
WHERE country_name = 'World' AND year = '2016') t2

Ans: 3.20824258980244

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?

SELECT country_name a_name, year, (total_area_sq_mi)*2.59 land
FROM land_area
WHERE year = '2016' AND
(total_area_sq_mi)*2.59 BETWEEN '1200000' AND '1500000'
ORDER BY 3 desc;

Ans: Peru (1279999.99)

2. REGIONAL OUTLOOK

Forestation Regional Table
CREATE TABLE "forestation" as (SELECT r.region,
f.year,100*(SUM(f.forest_area_sqkm))/(SUM(l.total_area_sq_mi)*2.59) percent_forest
FROM land_area l
JOIN forest_area f
ON l.country_code=f.country_code
JOIN regions r
ON f.country_code = r.country_code
WHERE f.forest_area_sqkm is not null and l.total_area_sq_mi is not null
GROUP BY 1,2,
ORDER BY 3)

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Based on the table you created, ...
a. What was the percent forest of the entire world in 2016? Which region had the HIGHEST percent forest in 2016, and which had the LOWEST,
to 2 decimal places?

SELECT * FROM
forestation
WHERE region='World' AND year ='2016'

Ans: World Region percent forest in 2016 was 31.38%

Max percent forestation
SELECT region, max(percent_forest)
FROM forestation
WHERE year = '2016'
GROUP BY 1
ORDER BY 2 desc;

Ans: Latin America & Caribbean had highest percent forest in 2016 (48.14%)

Min percent forestation
SELECT region, min(percent_forest)
FROM forestation
WHERE year = '2016'
GROUP BY 1
ORDER BY 2;

Ans: Middle East had least percent forest in 2016 (2.07%)

b. What was the percent forest of the entire world in 1990?

SELECT * FROM
forestation
WHERE region='World' AND year ='1990'

Ans: 32.42%

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Which region had the HIGHEST percent forest in 1990?
SELECT region, max(percent_forest)
FROM forestation
WHERE year = '1990'
GROUP BY 1
ORDER BY 2 desc;

Ans: Latin American & Caribbean (51.08%)

Which had the LOWEST, to 2 decimal places?
SELECT region, min(percent_forest)
FROM forestation
WHERE year = '1990'
GROUP BY 1
ORDER BY 2;

Ans: Minimum is Middle East & North America (1.77%)

c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

With t4 AS
(with t2 as (SELECT region, year, percent_forest
    FROM forestation
    WHERE year ='1990'),
t3 as (SELECT region, year, percent_forest
    FROM forestation
    WHERE year = '2016')
SELECT t2.region,t2.percent_forest pf1990, t3.percent_forest pf2016, ((t2.percent_forest) -
(t3.percent_forest)) pf_change
FROM t2
JOIN t3
ON t2.region = t3.region)
SELECT region, pf1990, pf2016, pf_change -- percent_forest_change
FROM t4
WHERE pf_change > 0
ORDER BY 4 DESC;

Ans: Latin America & Carribbean (4.95%), Sub-Saharan Africa (4.63%), World (1.04%)

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3. COUNTRY-LEVEL DETAIL

a1. country which saw increase in forest area

```
with t1 AS (SELECT r.region, f.country_name country, f.year AS year, f.forest_area_sqkm
forestarea
FROM forest_area f
JOIN regions r
ON f.country_name=r.country_name
WHERE f.forest_area_sqkm is not null AND f.country_name != 'World'),
t2 as (SELECT country, year, forestarea
    FROM t1
    WHERE year ='1990'),
t3 as (SELECT country, year, forestarea
    FROM t1
    WHERE year = '2016')
SELECT t1.region, t2.country, t2.forestarea fa_1990, t3.forestarea fa_2016,((t3.forestarea) -
(t2.forestarea)) fa_change -- forestation decrease
FROM t1
JOIN t2
ON t1.country = t2.country AND t1.year = t2.year
JOIN t3
ON t2.country = t3.country
ORDER BY 5 DESC
LIMIT 5
```

Ans: China (527229.06), United States (79200), India (69213.98), Russian Federation (59395), Vietnam (55390)

a2. country which saw highest percent forest increase between 1990 and 2016

```
with t1 AS (SELECT r.region, f.country_name country, f.year AS year, f.forest_area_sqkm
forestarea
FROM forest_area f
JOIN regions r
ON f.country_name=r.country_name
WHERE f.forest_area_sqkm is not null AND f.country_name != 'World'),
t2 as (SELECT country, year, forestarea
    FROM t1
    WHERE year ='1990'),
t3 as (SELECT country, year, forestarea
    FROM t1
    WHERE year = '2016')
```

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SELECT t1.region, t2.country, t2.forestarea fa_1990, t3.forestarea fa_2016, ABS((t2.forestarea) - (t3.forestarea))*100/(t2.forestarea) fa_change
FROM t1
JOIN t2
ON t1.country = t2.country AND t1.year = t2.year
JOIN t3
ON t2.country = t3.country
ORDER BY 5 DESC
LIMIT 5

Ans: Iceland (213.66%)

a. 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 t1 AS (SELECT r.region, f.country_name country, f.year AS year, f.forest_area_sqkm forestarea
FROM forest_area f
JOIN regions r
ON f.country_name=r.country_name
WHERE f.forest_area_sqkm is not null AND f.country_name != 'World'),
t2 as (SELECT country, year, forestarea
    FROM t1
    WHERE year ='1990'),
t3 as (SELECT country, year, forestarea
    FROM t1
    WHERE year = '2016')
SELECT t1.region, t2.country, t2.forestarea fa_1990, t3.forestarea fa_2016, ABS
((t2.forestarea) - (t3.forestarea)) fa_change
FROM t1
JOIN t2
ON t1.country = t2.country AND t1.year = t2.year
JOIN t3
ON t2.country = t3.country
ORDER BY 5 DESC
LIMIT 5

Ans: Brazil (541510), Indonesia (282193.984), Myanmar (10723.004), Nigeria (106506.000), Tanzania (102230)

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b. 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 t4 AS
(with t1 AS
  (SELECT f.country_name country, f.year AS year,
    SUM(f.forest_area_sqkm)/(SUM(l.total_area_sq_mi)*2.59) AS percent_forest
    FROM forest_area f
    JOIN land_area l
    ON f.country_name=l.country_name
    WHERE f.forest_area_sqkm is not null AND l.total_area_sq_mi is not null AND
f.country_name != 'World'
    GROUP BY 1,2),
  t2 as (SELECT country, year, percent_forest
    FROM t1
    WHERE year ='1990'),
  t3 as (SELECT country, year, percent_forest
    FROM t1
    WHERE year = '2016')
  SELECT t1.country, ((t2.percent_forest) - (t3.percent_forest))*100/(t2.percent_forest)
pf_change
  FROM t2
  JOIN t3
  ON t2.country = t3.country
  JOIN t1
  ON t1.country=t3.country
  GROUP BY 1)
SELECT r.region, t4.country, t4.pf_change
FROM t4
JOIN regions r
ON r.country_name=t4.country
ORDER BY 3 DESC;

Ans: Togo (75.4452%), Nigeria (61.7999%), Uganda (59.2733%), Mauritania (46.7469%), Honduras (45.0344%)

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

with t1 AS (SELECT f.country_name country,
(f.forest_area_sqkm)/((l.total_area_sq_mi)*2.59)*100 pf
FROM land_area l
JOIN forest_area f
ON l.country_code=f.country_code AND f.year = l.year

```
WHERE f.year = '2016'),
t2 AS (
SELECT country, pf, CASE WHEN pf > 0 AND pf < 25 THEN '0-25%'
WHEN pf >= 25 AND pf < 50 THEN '25%-50%' WHEN pf >= 50 AND pf < 75 THEN '50%-75%'
WHEN pf >= 75 AND pf < 100 THEN '75%-100%' END AS quartile
FROM t1)
SELECT t2.quartile, COUNT(t2.quartile) quartile_count
FROM t2
GROUP BY 1
ORDER BY 2 DESC;
```

Ans: 9 countries in top quartile

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

```
SELECT r.region, f.country_name country,
(f.forest_area_sqkm)/((l.total_area_sq_mi)*2.59)*100 pf -- percent forest
FROM land_area l
JOIN forest_area f
ON l.country_code=f.country_code AND f.year = l.year
JOIN regions r
ON r.country_name=f.country_name
WHERE f.year = '2016'AND pf >= 75 AND pf <100;
```

Ans: American Samoa, Micronesia Fed.Sts, Gabon, Guyana, Lao PDR, Palau, Solomon Islands, Suriname, and Seychelles

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

```
with t1 AS
    (SELECT f.country_name country, (f.forest_area_sqkm)/((l.total_area_sq_mi)*2.59)*100 pf
      FROM land_area l
      JOIN forest_area f
      ON l.country_code=f.country_code AND f.year = l.year
      WHERE f.year= '2016'),
t2 as (SELECT f.country_name country, (f.forest_area_sqkm)/((l.total_area_sq_mi)*2.59)*100 pf
      FROM land_area l
      JOIN forest_area f
      ON l.country_code=f.country_code AND f.year = l.year
      WHERE f.year= '2016' AND f.country_name='United States')
SELECT count(*)
FROM t1, t2
WHERE t1.pf > t2.pf
```
Ans: Count(94)