# ForestQuery Technology, Research & Enterprise

*A Business Intelligence Research into the global forestry situation from 1990 to 2016*

This study was conducted by ForestQuery's in-house BI & Analytics Consultant; Frederick Andaya Zoreta. The over-all research was conducted in conjunction with Udacity University & Udacity Enterprise Systems.

**Disclaimer: This cover letter is a part of an educational/ academic endeavor.

# 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 **41,282,694.9 square kilometers** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39,958,245.9 square kilometers**, a loss of **1,324,449 sq km** 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 1,289,000 sqkm**).

## 2. **REGIONAL OUTLOOK**

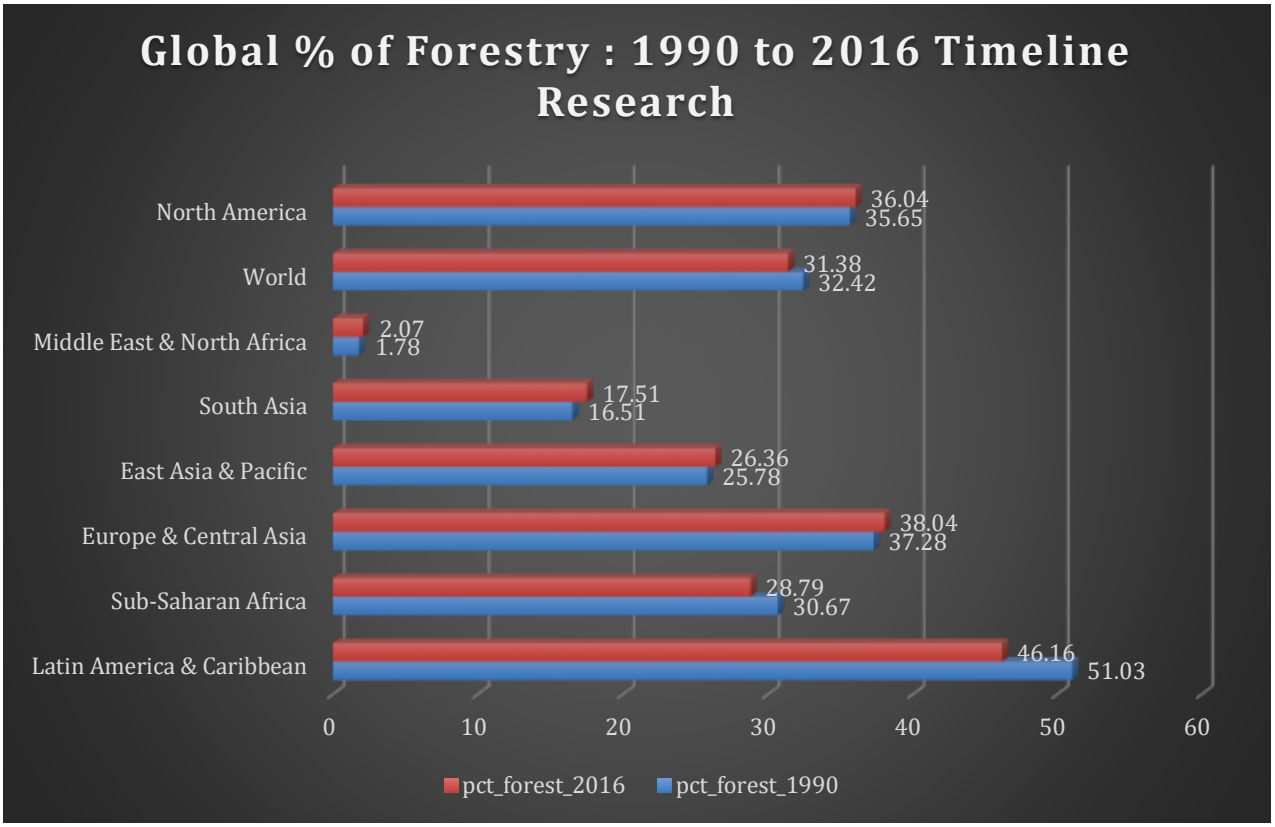
In 2016, the percent of the total land area of the world designated as forest was **31.38%.** The region with the highest relative forestation was **Latin America & Caribbean Islands**, with **46.16** %, and the region with the lowest relative forestation was **North Africa / Middle East** , with **2.07** % 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 **51.03** %, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.78** % forestation.

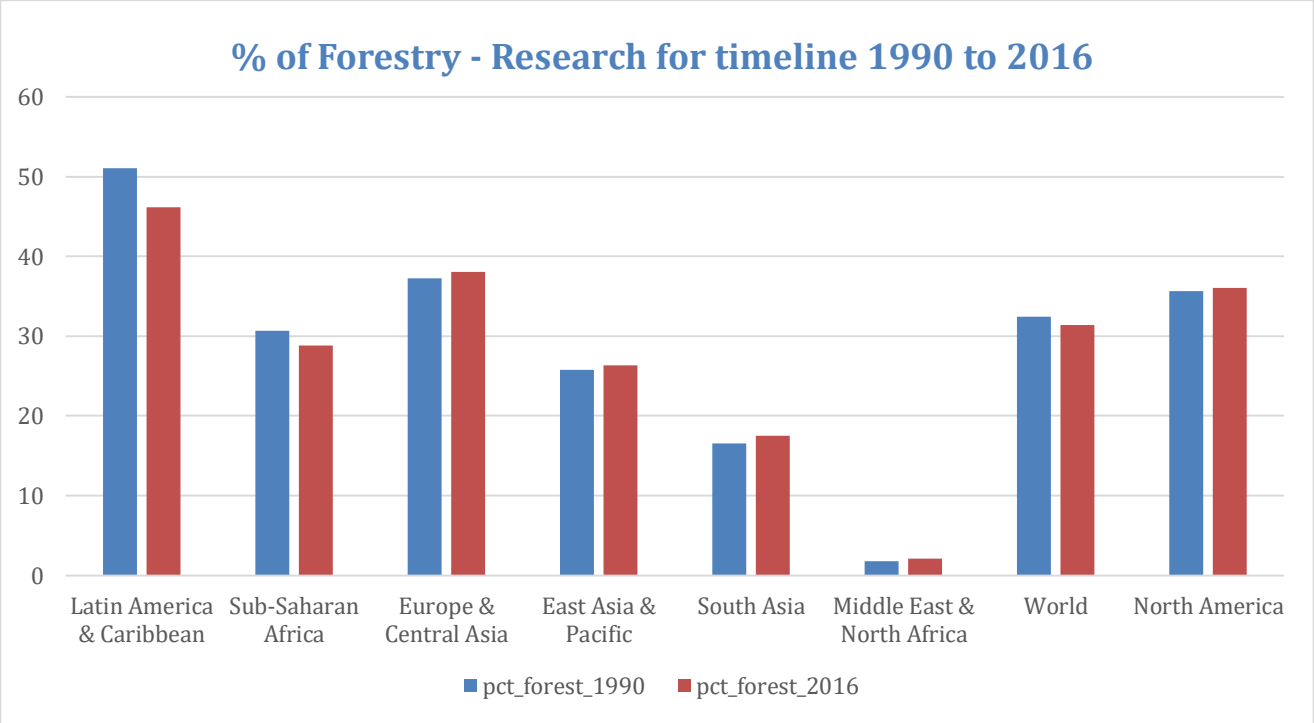
Table 2.1: Percent Forest Area by Region, 1990 & 2016:

| **Region** | ***1990 Forest Percentage*** | ***2016 Forest Percentage*** |
|---|---|---|
| Latin America & Caribbean Islands | **51.03 %** | **46.16 %** |
| Sub-Saharan Africa | **30.67%** | **28.79%** |
| Europe & Central Asia | **37.28%** | **38.04%** |
| East Asia & Pacific | **25.78%** | **26.36%** |
| South Asia | **16.51%** | **17.51%** |
| Middle East & North Africa | **1.78%** | **2.07%** |
| **WORLD** | **32.42%** | **31.38%** |
| North America | **35.65%** | **36.04%** |

Data Viz 1.1 Below shows a visual representation of the above findings.
** Numerical values presented below are the % values, as displayed on the above table.



Data Viz 1.2 Below is simply another 'perspective' or 'viewpoint' of the same data presented above. ** Numerical values are % values.




The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & the Caribbean Region (dropped from **51.03 %** to **46.16 %)** and the Sub-Saharan African continent (**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, **People's Republic of China**. This country actually increased in forest area from 1990 to 2016 by **527,229.06 square kilometers**. 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 of America**, but it only saw an increase of **79,200.00 sq km**, much lower than the figure for **China , PRC**.

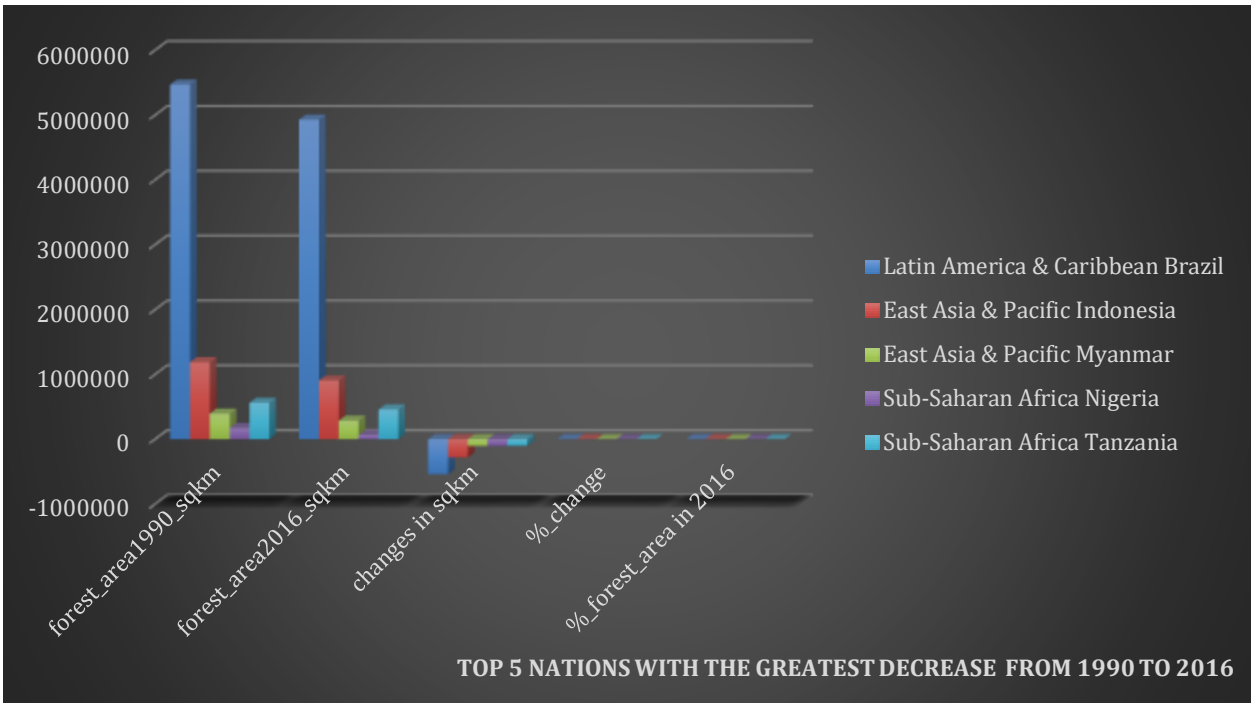
**China** and **United States** are of course very large countries in total land area, so when we look at the largest *percent* change in forest area from 1990 to 2016, we aren't surprised to find a much smaller country listed at the top. **Iceland** increased in forest area by **213.66** % from 1990 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*** | **541,510 sq kms** |
| Indonesia | ***East Asia & Pacific*** | **282,193 sq kms** |
| Myanmar | ***East Asia & Pacific*** | **107,234 sq kms** |
| Nigeria | ***Sub-Saharan Africa*** | **106,506 sq kms** |
| Tanzania | ***Sub-Saharan Africa*** | **102,320 sq kms** |



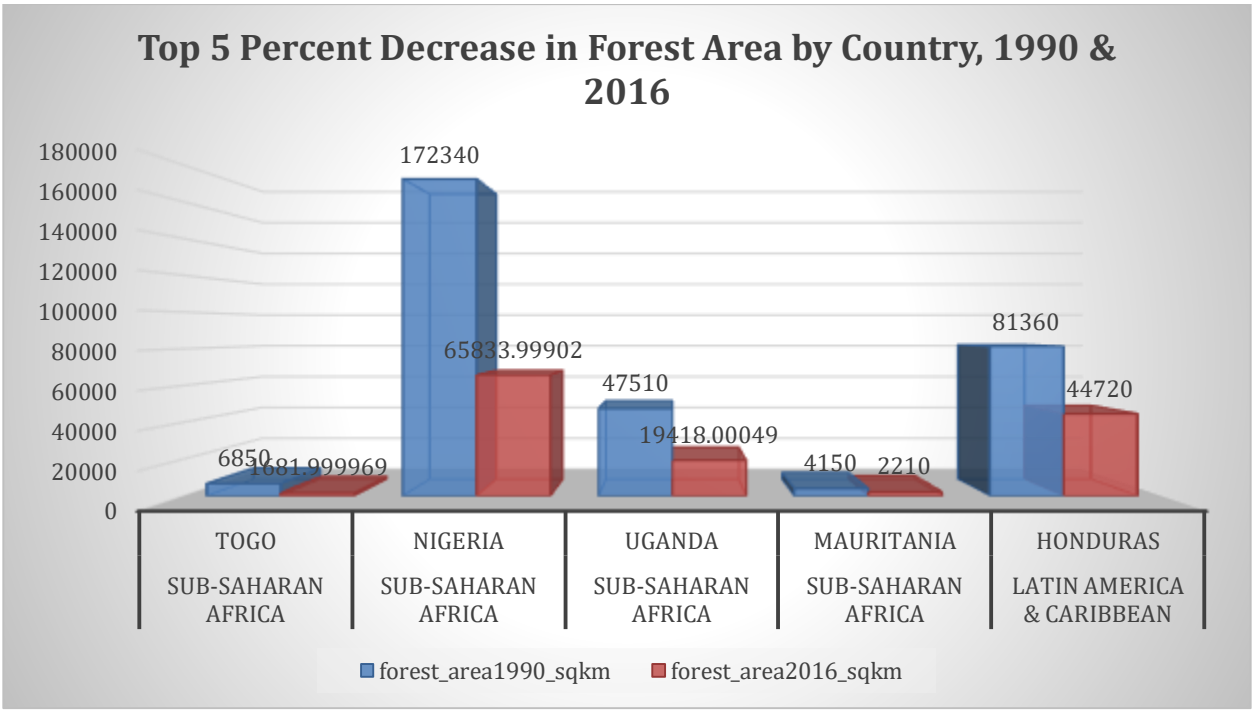

Dataviz 3.1. Above simply shows top 5 amount decrease in forest area by country, 1990 & 2016:

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:

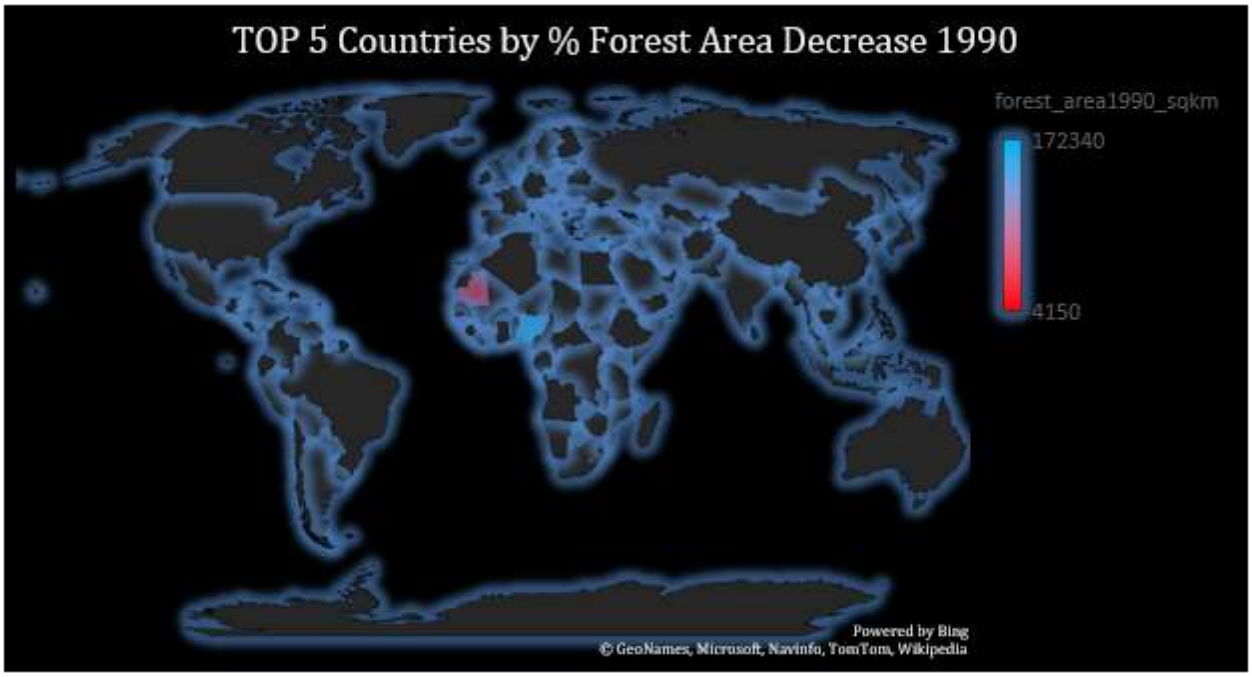
| Country | Region | Pct Forest Area Change |
|---|---|---|
| Togo | **Sub-Saharan Africa** | **75.45 %** |
| Nigeria | **Sub-Saharan Africa** | **61.80 %** |
| Uganda | **Sub-Saharan Africa** | **59.13 %** |
| Mauritania | **Sub-Saharan Africa** | **46.75 %** |
| Honduras | **Latin America & Caribbean** | **45.03 %** |

Dataviz 3.2.A shows a graphical representation of the Top 5 % decrease in forest area by country, years 1990 and 2016.

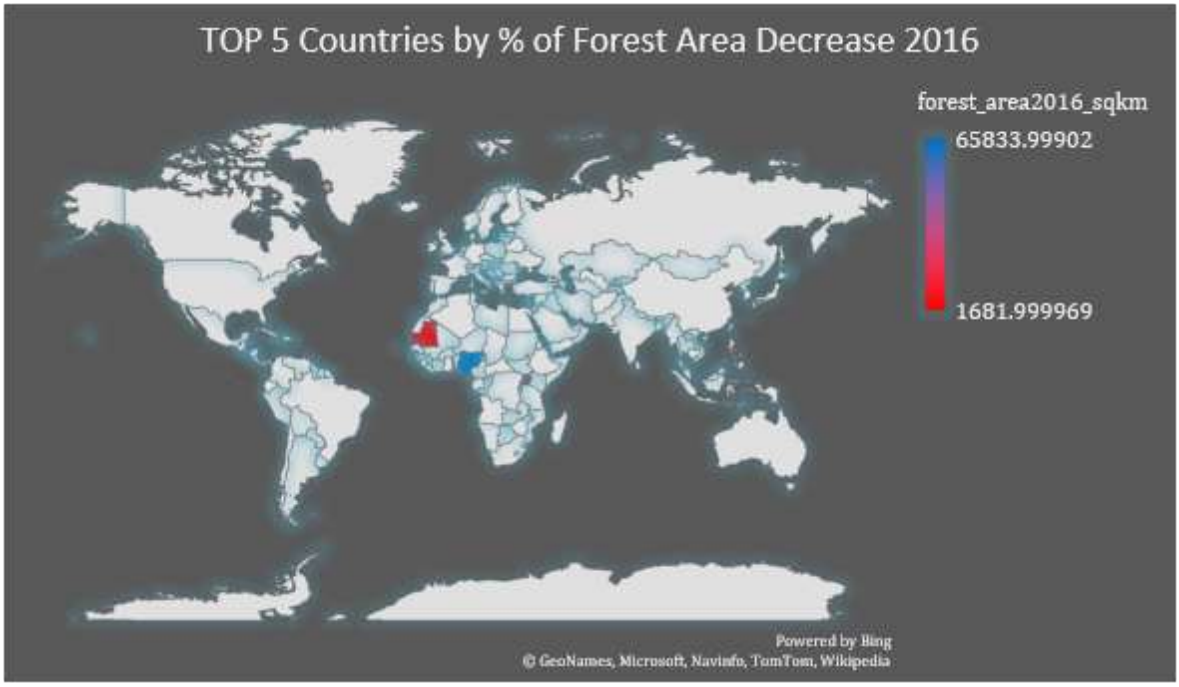



Dataviz 3.2.B Displays the same metrics as the above tables, but only for 1990

** Red color refers to the lower limits(Mauritania), blue color refers to the upper limits (Nigeria)



Dataviz 3.2.C Displays the same metrics as the above tables, but only for 2016
** Red color refers to the lower limits(Mauritania), blue color refers to the upper limits (Nigeria)




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**, **Uganda**, **Mauritania**, and **Nigeria**. The 5th country on the list is **Honduras**, which is in **the Latin American & Caribbean Islands** 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 |
|---|---|
| 1 | 85 |
| 2 | 72 |
| 3 | 38 |
| 4 | 9 |

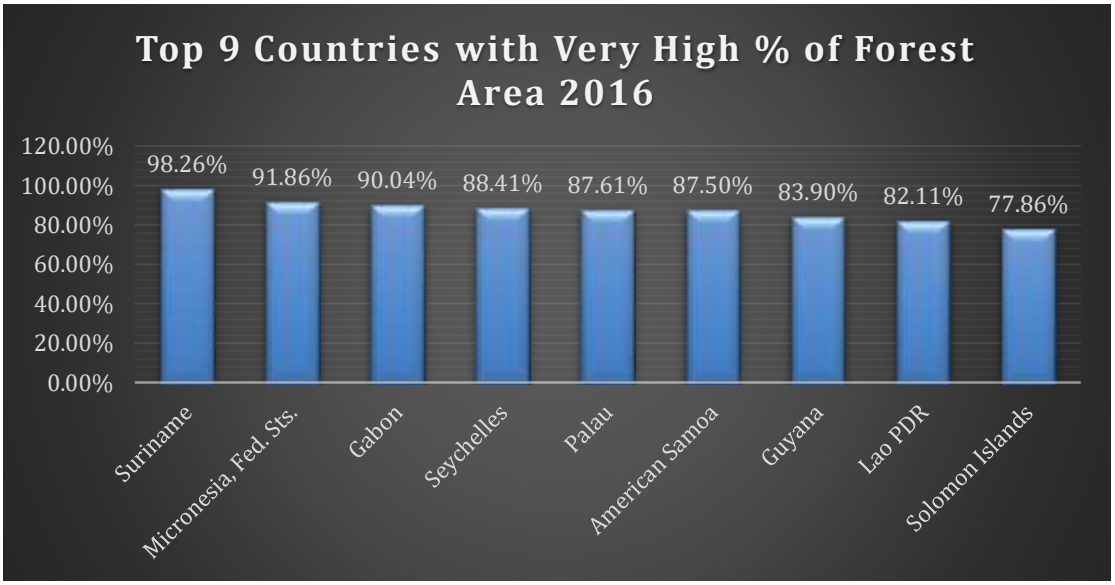
The largest number of countries in 2016 were found in the **First** quartile.

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 African** | **90.04 %** |
| ***Seychelles*** | **Sub-Saharan Africa** | **88.41 %** |
| ***Palau*** | **East Asia & Pacific** | **87.61 %** |
| ***American Samoa*** | **East Asia & Pacific** | **87.51 %** |
| ***Guyanese*** | **Latin America & Caribbean** | **83.90 %** |
| ***Lao , Dem Republic*** | **East Asia & Pacific** | **82.11 %** |
| ***Salomon Islands*** | **East Asia & Pacific** | **77.86 %** |

Dataviz 3.4 (below)shows a graphical representation of the top 9 nations with the highest % of forestry area in the year 2016.



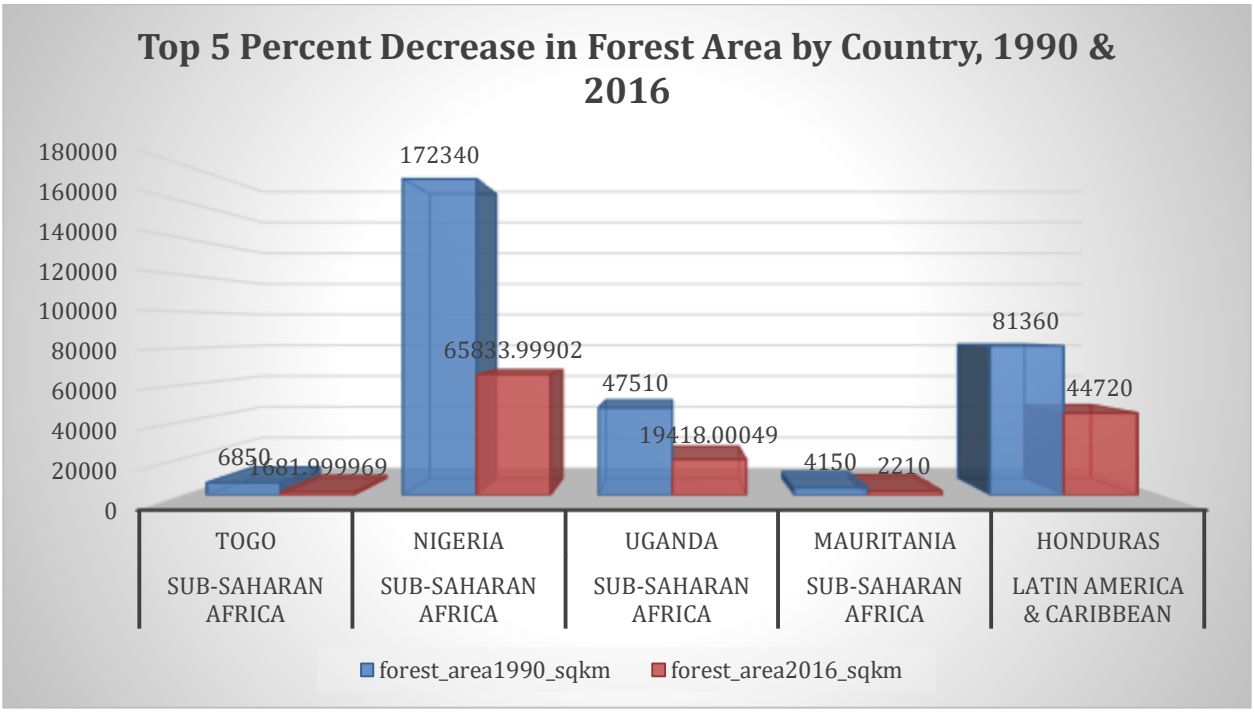

# 5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
- *Which countries should we focus on over others?*

There are indeed a few recommendations that I, as an analyst could give.

I would like to go back and 'quote' my findings on the chart below:
Dataviz 3.2.A shows a graphical representation of the Top 5 % decrease in forest area by country, years 1990 and 2016.




****This data is very powerful and informative. 4 out of the top 5 are in the sub-saharan African region. If we are going to focus on Nigeria, this country has been consistent from 1990 until 2016 as having the HIGHEST decrease in forest area. Of course, there could be a variety of factors, not just in Nigeria but in all the 3 other Sub-Saharan African nations:**

A. **Geo-political situation ; presence of unrest**
B. **Economic instability**
C. **Transparency ( or lack thereof ) with regards to government policies on forestry and other environmental factors**
D. **Security , policing and actual law enforcement. Do they even exist in monitoring the forestry situation in these countries, especially in Nigeria.**

On top of the % decrease in forest area, the table below also shows that Nigeria is present:

| Country | Region | Absolute Forest Area Change |
|---|---|---|
| Brazil | ***Latin America & Caribbean*** | **541,510 sq kms** |
| Indonesia | ***East Asia & Pacific*** | **282,193 sq kms** |
| Myanmar | ***East Asia & Pacific*** | **107,234 sq kms** |
| Nigeria | ***Sub-Saharan Africa*** | **106,506 sq kms** |
| Tanzania | ***Sub-Saharan Africa*** | **102,320 sq kms** |

One last suggestion, which would need a much deeper analysis and may include more specialized skills in the areas of “econometrics, economics, geo-spatial analysis, politics, geo-political analysis and even international law enforcement agencies”.

The table below shows the changes in % of forest by comparing 1990 and 2016. Although this may appear ‘super accurate’, it would entail a MUCH HIGHER LEVEL of GRANULARITY. These are differences in regions. Each region has several countries within it, that has similarities and differences in culture, economy, policy enforcements, trade deals, population count, weather, etc.

| REGION | 1990 – Percentage of Forest | 2016 – Percentage of Forest |
|---|---|---|
| Latin America & Caribbean | 51.03 | 46.16 |
| Sub-Saharan Africa | 30.67 | 28.79 |
| Europe & Central Asia | 37.28 | 38.04 |
| East Asia & Pacific | 25.78 | 26.36 |
| South Asia | 16.51 | 17.51 |
| Middle East & North Africa | 1.78 | 2.07 |
| World | 32.42 | 31.38 |
| North America | 35.65 | 36.04 |

North America , Europe & Central Asia , East Asia & Pacific, South Asia and Middle East / North Africa all increased by 2016. Was there common factors among the nations within each region? Was there any policy and method being used? Could it be that only 2 or 3 nations have ‘carried the weight’ and thereby increased the % of forest by 2016?

As mentioned above, there should be a MUCH DEEPER LEVEL of ANALYSIS ( Granularity) in order to drill down the exact reasons.

The CTE_Query used in retrieving the table above was:

```
WITH CTE_Unit1 AS
(
 SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name)
 AS country_attributes,
 COALESCE(forests_year,lands_year) AS yr,
 (forest_area_sqkm/2.59) AS forest_area_sqmi,
 total_area_sq_mi
 FROM forestation
```

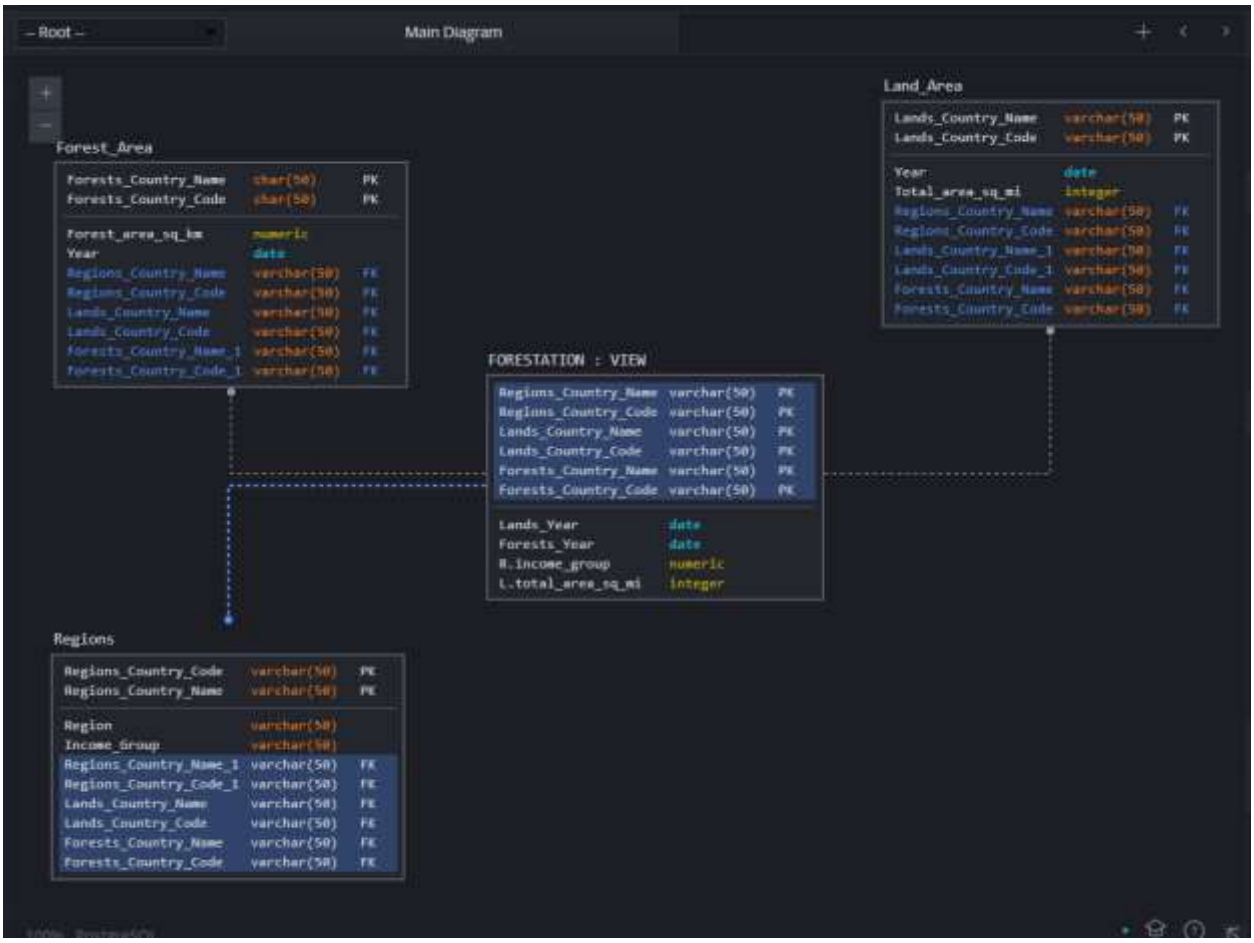
```
 WHERE COALESCE(lands_year,forests_year) IN (1990,2016)
),
CTE_Year1990 AS
(
 SELECT region,
 SUM(forest_area_sqmi) AS total_forests_sqmi1990,
 SUM(total_area_sq_mi) AS total_lands_sqmi1990
 FROM CTE_Unit1
 WHERE yr = 1990
 GROUP BY region
),
CTE_Year2016 AS
(
 SELECT region,
 SUM(forest_area_sqmi) AS total_forests_sqmi2016,
 SUM(total_area_sq_mi) AS total_lands_sqmi2016
 FROM CTE_Unit1
 WHERE yr = 2016
 GROUP BY region
)
SELECT CTE_Year1990.region,
 ROUND((total_forests_sqmi1990/total_lands_sqmi1990*100)::numeric,2)
 AS pct_forest_1990,
 ROUND((total_forests_sqmi2016/total_lands_sqmi2016*100)::numeric,2)
 AS pct_forest_2016
FROM CTE_Year1990
INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.region = CTE_Year2016.region;
```

**APPENDIX: Includes the following details:**

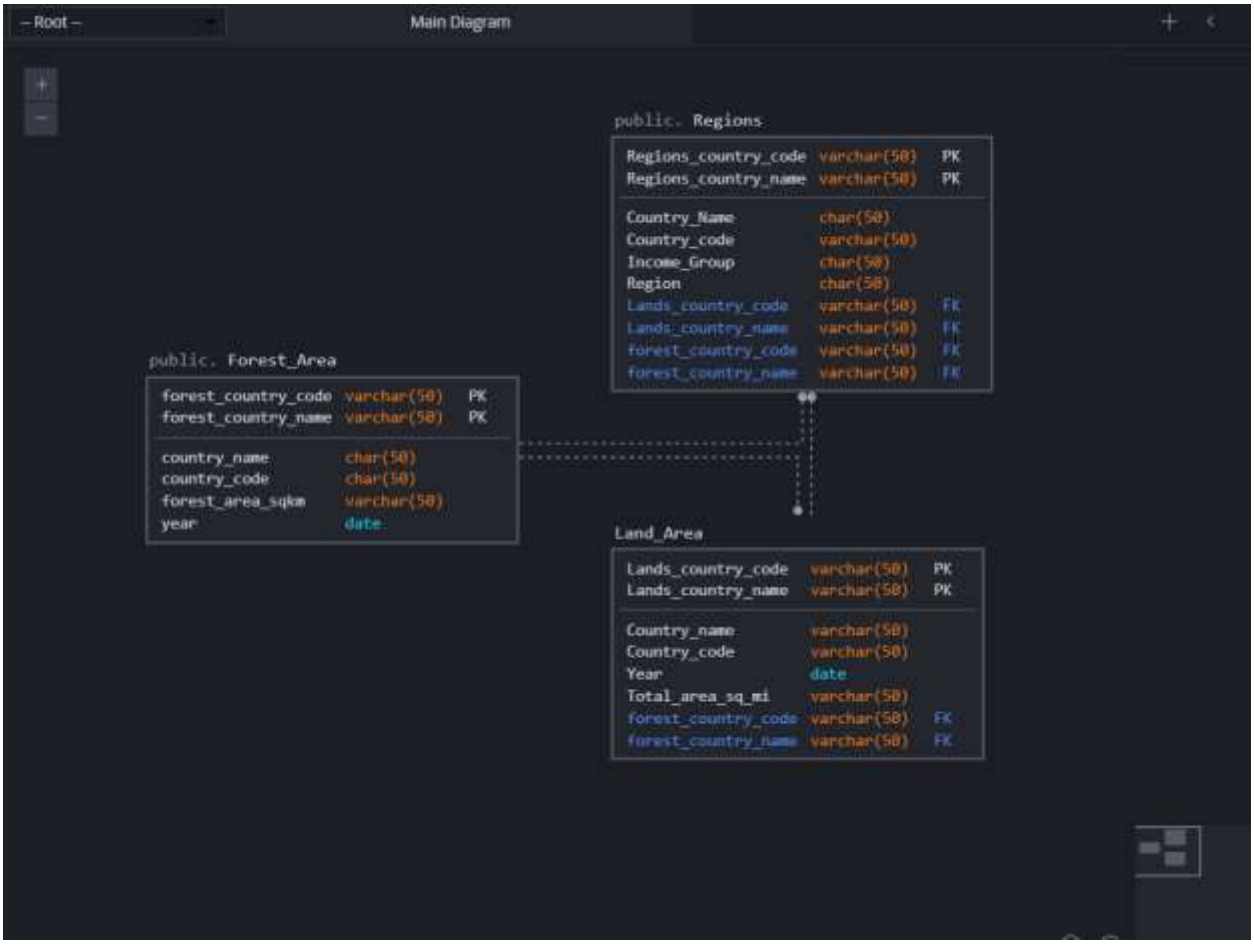
1.SQL Scripts/ Queries
2.Entity Relational Diagrams (only serving as an outline & guide.)
3.Other sources of educational materials being used

**Notice: ALL the Graphs / tables were my own creation, simply using MS Excel.
** The ERD diagram was created after I have already done the scripts/ queries.
** I included explanations in all the SQL codes. I have repeated the entire appendix of codes afterwards, without any explanations nor table at all.

A Conceptual Overview/ Basic Entity Relationship Diagram for ForestQuery's project:
Version 1: The 'Forestation View' connects all three tables



A Second ERD that shows NO Forestation_View:




Sources of information and disclaimer:

I, Frederick Zoreta, have used outside resources (other than Udacity) in learning and practicing SQL. I have listed the exact links and lectures that I have been using for more than 1 year.

1.www.datacamp.com

My academic profile: https://www.datacamp.com/profile/ericzoreta808

Similar courses utilized in research/practice of SQL:

Joining Data in PostgreSQL:

https://learn.datacamp.com/courses/joining-data-in-postgresql

Exploratory Data Analysis in SQL:
https://learn.datacamp.com/courses/exploratory-data-analysis-in-sql
Intermediate SQL:
https://learn.datacamp.com/courses/intermediate-sql
PostGreSQL Summary Stats & Window Functions:
https://learn.datacamp.com/courses/postgresql-summary-stats-and-window-functions
Analyzing Business Data in SQL:
https://learn.datacamp.com/courses/analyzing-business-data-in-sql
Applying SQL to the Real World :
https://learn.datacamp.com/courses/applying-sql-to-real-world-problems
Improving PostGreSQL Query Performance:
https://learn.datacamp.com/courses/improving-query-performance-in-postgresql
Creating PostGreSQL Databases:
https://learn.datacamp.com/courses/creating-postgresql-databases

2.www.TeamTreeHouse.com

My academic profile: https://teamtreehouse.com/frederickzoreta

Similar courses utilized in research/practice of SQL:

Reporting with SQL:
https://teamtreehouse.com/library/reporting-with-sql
Querying Relational Databases:
https://teamtreehouse.com/library/querying-relational-databases
Common Table Expressions (CTE) using WITH() Function:
https://teamtreehouse.com/library/common-table-expressions-using-with
Modifying Data with SQL:
https://teamtreehouse.com/library/modifying-data-with-sql

3.www.udemy.com

My academic profile: https://www.udemy.com/user/fredrickzoreta/

Similar courses utilized in research/practice of SQL:

MySQL for Data Analysis:
https://www.udemy.com/course/mysql-for-data-analysis/learn/lecture/15211486#overview
Advanced MySQL for Data Analytics:
https://www.udemy.com/course/advanced-sql-mysql-for-analytics-business-intelligence/learn/lecture/16450492#overview

The Complete SQL Bootcamp- Zero to Hero :
https://www.udemy.com/course/the-complete-sql-bootcamp/
Mastering SQL for Data Science:
https://www.udemy.com/course/master-sql-for-data-science/
The Complete Oracle Course:
https://www.udemy.com/course/the-complete-oracle-sql-certification-course/

**Entire SQL scripts are included again at the end without any explanations nor tables.
SQL Code being used in the entire project (with simple explanations and tables):

**1.Creating a view called "Forestation"**

```
CREATE VIEW forestation AS
SELECT r.region,
l.year AS lands_year,
 f.forest_area_sqkm,
 l.total_area_sq_mi,
 r.income_group,
 l.country_name AS lands_country_name,
 f.country_name AS forests_country_name,
 r.country_name AS regions_country_name,
 f.country_code AS forests_country_code,
 l.country_code AS lands_country_code,
 r.country_code AS regions_country_code,
 f.year AS forests_year,
 (f.forest_area_sqkm / 2.59) / l.total_area_sq_mi*100
 AS percent_forest_area
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 l.country_code = r.country_code;
```

2.**The Global Outlook Analysis :**

**The query below results in the total forest area in sq km in the year 1990
** COALESCE function has helped me in dealing with potential NULL values

```
SELECT  (forests_country_name, lands_country_name, regions_country_name) AS country_attributes,
 forest_area_sqkm AS Forestry_area1990_sqkm
 FROM Forestation
 WHERE COALESCE(lands_year, forests_year) = 1990
 AND
 COALESCE(forests_country_name, lands_country_name, regions_country_name) = 'World'
```

**Note: Answer: The above query yielded the result of 41282694.9 square kilometers for the year 1990.**

**The query below results in the total forest area in sq km in the year 2016.

```
SELECT COALESCE(Forests_country_name, Lands_country_name, Regions_country_name) AS
country_attributes,
 Forest_area_sqkm AS Forestry_area2016_sqkm
 FROM Forestation
 WHERE COALESCE(Lands_year, Forests_year) = 2016
 AND
 COALESCE (Forests_country_name, Lands_country_name, Regions_country_name) = 'World'
```

**Answer : The above query yielded the result of 39958245.9 square kilometers for the year 2016.**

*Note: I did an alternative which shows the 'side by side' comparison between the years 1990 and 2016. It was a pretty long and complicated query, which by far could be solved MUCH FASTER by simply using manual calculations as show above.*
*The said query is below:*

```
SELECT COALESCE(forests_country_name, lands_country_name, regions_country_name) AS
country,  forest_area_sqkm AS Forestry_area1990_sqkm
 FROM Forestation
 WHERE COALESCE(lands_year, forests_year) = 1990  AND
 COALESCE(forests_country_name, lands_country_name, regions_country_name) = 'World'
UNION ALL

SELECT COALESCE(Forests_country_name, Lands_country_name, Regions_country_name) AS
country,  Forest_area_sqkm AS Forestry_area2016_sqkm
 FROM Forestation
 WHERE COALESCE(Lands_year, Forests_year) = 2016
 AND
 COALESCE(Forests_country_name, Lands_country_name, Regions_country_name) = 'World'
```

- **The questions above could be answered by doing a manual or simple subtraction. The year 1990 has (41282694.9 square kilometers ) MINUS (39958245.9 square kilometers) from year 2016.**

  **The result is: 1, 324, 449 square kilometers. That would equate to 3.21%**

**/ I figured out to utilize Common Table Expressions, specifically the WHERE() Clause since it would make it easier, despite having a longer sql script. The entire query below was enough to answer the questions for the Global Outlook series.

```
WITH CTE_Year1990 AS
( SELECT COALESCE (regions_country_name, forests_country_name,  lands_country_name) AS
country_attributes,
 forest_area_sqkm AS f_area1990_sqkm
 FROM forestation
 WHERE COALESCE(forests_year, lands_year) = 1990
 AND
 COALESCE (forests_country_name, lands_country_name, regions_country_name) = 'World' ),
CTE_Year2016 AS
(SELECT COALESCE (forests_country_name, lands_country_name, regions_country_name) AS
country_attributes,
 forest_area_sqkm AS f_area2016_sqkm
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016
 AND
 COALESCE (lands_country_name, regions_country_name, forests_country_name) = 'World' ),
CTE_World1 AS
 (SELECT CTE_Year1990.country_attributes,
 CTE_Year1990.f_area1990_sqkm,
 CTE_Year2016.f_area2016_sqkm,
 (CTE_Year2016.f_area2016_sqkm-CTE_Year1990.f_area1990_sqkm) AS differences_sqkm,
 ROUND(((CTE_Year2016.f_area2016_sqkm -
CTE_Year1990.f_area1990_sqkm)/CTE_Year1990.f_area1990_sqkm*100)::numeric,2)
 AS changes_percentage
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes),
CTE_World2 AS
 (SELECT COALESCE (FOREST_Master.forests_country_name, FOREST_Master.lands_country_name,
FOREST_Master.regions_country_name) AS country_nearest_proximity_diff,
 ROUND((FOREST_Master.total_area_sq_mi*2.59)::numeric,0) AS land_area_sqkm ,
```

```
 ABS(ABS(CTE_World1. differences_sqkm /2.59)-FOREST_Master.total_area_sq_mi) AS differences_in_value

 FROM forestation AS FOREST_Master, CTE_World1
 WHERE COALESCE(FOREST_Master.lands_year, FOREST_Master.forests_year) = 2016
 AND
 COALESCE(FOREST_Master.lands_country_name, FOREST_Master.regions_country_name,
FOREST_Master.forests_country_name) !=  'World'
 ORDER BY 2 ASC
 LIMIT 1)

SELECT CTE_World1.*, CTE_World2. country_nearest_proximity_diff, CTE_World2.land_area_sqkm
FROM CTE_World1, CTE_World2;
```

**3.Regional Outlook Analysis**

**Originally , I did the single query below, which simply SELECTS the following:**

**The regions, the countries, the year (1990 & 2016), the forest area square miles and total area square miles:**

```
SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name)
 AS country_attributes,
 COALESCE(forests_year,lands_year) AS yr,
 (forest_area_sqkm/2.59) AS forest_area_sqmi,
 total_area_sq_mi
 FROM forestation
 WHERE COALESCE(lands_year,forests_year) IN (1990,2016)
```

**This query yielded 436 rows.  I figured this query is not enough. It's technically the same as doing a: SELECT * FROM forestation WHERE year IN (1990, 2016).**

**I then used Common Table Expressions , using mainly the WINDOW() , so as to minimize using continuous sub queries. It is a longer one, but gave me the right result:**

```
WITH CTE_Unit1 AS
(
 SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name)
 AS country_attributes,
 COALESCE(forests_year,lands_year) AS yr,
```

```
 (forest_area_sqkm/2.59) AS forest_area_sqmi,
 total_area_sq_mi
 FROM forestation
 WHERE COALESCE(lands_year,forests_year) IN (1990,2016)
),
CTE_Year1990 AS
(
 SELECT region,
 SUM(forest_area_sqmi) AS total_forests_sqmi1990,
 SUM(total_area_sq_mi) AS total_lands_sqmi1990
 FROM CTE_Unit1
 WHERE yr = 1990
 GROUP BY region
),
CTE_Year2016 AS
(
 SELECT region,
 SUM(forest_area_sqmi) AS total_forests_sqmi2016,
 SUM(total_area_sq_mi) AS total_lands_sqmi2016
 FROM CTE_Unit1
 WHERE yr = 2016
 GROUP BY region
)
SELECT CTE_Year1990.region,
 ROUND((total_forests_sqmi1990/total_lands_sqmi1990*100)::numeric,2)
 AS pct_forest_1990,
 ROUND((total_forests_sqmi2016/total_lands_sqmi2016*100)::numeric,2)
 AS pct_forest_2016
FROM CTE_Year1990
INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.region = CTE_Year2016.region;
```

**The above CTE Query yielded the table result below:**

**** The above query yields results such as the table below:**

| REGION | 1990 – Percentage of Forest | 2016 – Percentage of Forest |
|---|---|---|
| Latin America & Caribbean | 51.03 | 46.16 |
| Sub-Saharan Africa | 30.67 | 28.79 |
| Europe & Central Asia | 37.28 | 38.04 |
| East Asia & Pacific | 25.78 | 26.36 |
| South Asia | 16.51 | 17.51 |
| Middle East & North Africa | 1.78 | 2.07 |
| World | 32.42 | 31.38 |
| North America | 35.65 | 36.04 |

**4.Country Level Detail Queries**

**The entire CTE Query below answered all the questions for the country level details. There were just minor changes in the following questions:**

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS country_attributes
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
(
 SELECT CTE_Year1990.region,
 CTE_Year1990.country_attributes,
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS
changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeric,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
```

```
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC
)
SELECT *
FROM CTE_Global
WHERE changes_sqkm IS NOT NULL
ORDER BY changes_sqkm ASC
LIMIT 5;
```

**** The first question in this chapter asks " Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?" . Hence I LIMITED to 5**

**The result of this query is shown below:**

| region | country_attributes | forest_area1990_sqkm | forest_area2016_sqkm | changes_sqkm | p |
|---|---|---|---|---|---|
| Latin America & Caribbean | Brazil | 5467050 | 4925540 | -541510 | |
| East Asia & Pacific | Indonesia | 1185450 | 903256.0156 | -282193.98 | |
| East Asia & Pacific | Myanmar | 392180 | 284945.9961 | -107234 | |
| Sub-Saharan Africa | Nigeria | 172340 | 65833.99902 | -106506 | |
| Sub-Saharan Africa | Tanzania | 559200 | 456880 | -102320 | |

**The following questions were answered by using the same WITH Clause, with very minimal changes.**

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS country_attributes
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
```

```
(
 SELECT CTE_Year1990.region,
 CTE_Year1990.country_attributes,
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS
changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeric,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC
)
SELECT *
FROM CTE_Global
WHERE pct_change IS NOT NULL
ORDER BY pct_change DESC
LIMIT 1;
```

**The query above answers the question in the document :
we aren't surprised to find a much smaller country listed at the top. _____ increased in forest area by _____% from 1990 to 2016.

Hence, it resulted in the table below:

| region | country_attributes | forest_area1990_sqkm | forest_area2016_sqkm | changes_sqkm | pct_change | pct_forest_area_2016 |
|---|---|---|---|---|---|---|
| Europe & Central Asia | Iceland | 161.0000038 | 505 | 344 | 213.66 | 0.5 |

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS country_attributes
 FROM forestation
```

```
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
(
 SELECT CTE_Year1990.region,
 CTE_Year1990.country_attributes,
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS
changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeric,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC
)
SELECT *
FROM CTE_Global
WHERE changes_sqkm IS NOT NULL
ORDER BY changes_sqkm ASC
LIMIT 5;
```

| region | country_attributes | forest_area1990_sqkm | forest_area2016_sqkm | changes_sqkm |
|---|---|---|---|---|
| Latin America & Caribbean | Brazil | 5E+06 | 4925540 | -5415 |
| East Asia & Pacific | Indonesia | 1E+06 | 903256.0156 | -282193.9 |
| East Asia & Pacific | Myanmar | 392180 | 284945.9961 | -1072 |
| Sub-Saharan Africa | Nigeria | 172340 | 65833.99902 | -1065 |
| Sub-Saharan Africa | Tanzania | 559200 | 456880 | -1023 |

**** The second question in 'Country Level Details' was asking : "**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? **". So the above CTE Query answers this question, instead of DESC, I used ASC.**

**The 2nd to the last question in 'Country Level Details' was asking to 'List ALL Countries that were in the 4th Quartile (percentage forest > 75 %) in 2016.**

**Initially, I did several steps. The first step below simply gives the countries who are not classified as 'World', the % of forest area is NOT NULL, rounded off the % of forestry area and made sure the year was 2016. This yielded 204 results.**

```
SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name) AS
country_attributes,
 ROUND(percent_forest_area::NUMERIC,2) AS forest_area_pct
 FROM forestation
 WHERE COALESCE(forests_year,lands_year) = 2016 AND region != 'World'
 AND percent_forest_area IS NOT NULL
```

**** At this point, I have to get the over-all quartiles ranges using a 'CASE WHEN' Statements such as the one below:**

```
CASE WHEN forest_area_pct > 75.00 THEN 'Quartile_4'
 WHEN forest_area_pct > 50.00 AND forest_area_pct <= 75.00 THEN 'Quartile_3'
 WHEN forest_area_pct > 25.00 AND forest_area_pct <= 50.00 THEN 'Quartile_2'
 ELSE 'Quartile_1' END AS quartile_ranges
```

**So, below is the actual, FULL QUERY using Common Table Expressions.**

```
WITH CTE_Quartile1 AS
(
 SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name) AS
country_attributes,
 ROUND(percent_forest_area::NUMERIC,2) AS forest_area_pct
 FROM forestation
 WHERE COALESCE(forests_year,lands_year) = 2016 AND region != 'World'
 AND percent_forest_area IS NOT NULL
),
CTE_Quartile2 AS
(
```

```
 SELECT country_attributes, forest_area_pct, region,

 CASE WHEN forest_area_pct > 75.00 THEN 'Quartile_4'
 WHEN forest_area_pct > 50.00 AND forest_area_pct <= 75.00 THEN 'Quartile_3'
 WHEN forest_area_pct > 25.00 AND forest_area_pct <= 50.00 THEN 'Quartile_2'
 ELSE 'Quartile_1' END AS quartile_ranges

 FROM CTE_Quartile1
)
SELECT quartile_ranges, COUNT(quartile_ranges)
FROM CTE_QuarTile2
GROUP BY quartile_ranges
ORDER BY quartile_ranges ASC;
```

---

The full CTE Clause gave result to the Quartile table below:

| quartile_ranges | count |
|---|---|
| Quartile_1 | 85 |
| Quartile_2 | 72 |
| Quartile_3 | 38 |
| Quartile_4 | 9 |

```
WITH CTE_Query1 AS
(
 SELECT region,
ROUND(percent_forest_area::numeric,2) AS forest_area_pct,
 COALESCE (lands_country_name, regions_country_name, forests_country_name) AS
country_attributes

 FROM forestation
 WHERE COALESCE(forests_year, lands_year) = 2016 AND region != 'World'
 AND percent_forest_area IS NOT NULL
),

CTE_Query2 AS
(
 SELECT region, forest_area_pct,  country_attributes,

 CASE WHEN forest_area_pct > 75.00 THEN 'Quartile_4'
 WHEN forest_area_pct > 50.00 AND forest_area_pct <= 75.00 THEN 'Quartile_3'
 WHEN forest_area_pct > 25.00 AND forest_area_pct <= 50.00 THEN 'Quartile_2'
 ELSE 'Quartile_1' END AS  quartile_ranges

FROM CTE_Query1
```

```
)
SELECT *
FROM CTE_Query2
WHERE quartile_ranges = 'Quartile_4'
ORDER BY forest_area_pct  DESC;
```

****The query above yielded the table below:**

| region | country_attributes | pct_forest_area | quartile_ranges |
|---|---|---|---|
| Latin America & Caribbean | Suriname | 98.26 | 4 |
| East Asia & Pacific | Micronesia, Fed. Sts. | 91.86 | 4 |
| Sub-Saharan Africa | Gabon | 90.04 | 4 |
| Sub-Saharan Africa | Seychelles | 88.41 | 4 |
| East Asia & Pacific | Palau | 87.61 | 4 |
| East Asia & Pacific | American Samoa | 87.5 | 4 |
| Latin America & Caribbean | Guyana | 83.9 | 4 |
| East Asia & Pacific | Lao PDR | 82.11 | 4 |
| East Asia & Pacific | Solomon Islands | 77.86 | 4 |

**The last and final CTE_Query answers the question : "How many countries had a percent forestation higher/greater than the United States?**

```
WITH USA_QUERY AS
(
 SELECT COALESCE (lands_country_name, forests_country_name,regions_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest2016
 FROM forestation
 WHERE COALESCE(forests_year,lands_year) = 2016 AND region != 'World'
 AND percent_forest_area IS NOT NULL
)
SELECT COUNT(*) AS nations_greater_than_USA
FROM USA_QUERY
WHERE pct_forest2016 > (
 SELECT pct_forest2016
 FROM USA_QUERY
 WHERE country_attributes = 'United States'
 );
```

**SECOND APPENDIX of SQL Code ( Excatly the same, but with no tables and sentences):**

**1.Create a 'Forestation' View:**

```
CREATE VIEW forestation AS
SELECT r.region,
l.year AS lands_year,
 f.forest_area_sqkm,
 l.total_area_sq_mi,
 r.income_group,
 l.country_name AS lands_country_name,
 f.country_name AS forests_country_name,
 r.country_name AS regions_country_name,
 f.country_code AS forests_country_code,
 l.country_code AS lands_country_code,
 r.country_code AS regions_country_code,
 f.year AS forests_year,
 (f.forest_area_sqkm / 2.59) / l.total_area_sq_mi*100
 AS percent_forest_area
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 l.country_code = r.country_code;
```

**2.Global Outlook Analysis:**

(single query only)

```
SELECT  (forests_country_name, lands_country_name, regions_country_name) AS country_attributes,
 forest_area_sqkm AS Forestry_area1990_sqkm
 FROM Forestation
 WHERE COALESCE(lands_year, forests_year) = 1990
 AND
 COALESCE(forests_country_name, lands_country_name, regions_country_name) = 'World'
```

**Note: Answer: The above query yielded the result of 41282694.9 square kilometers for the year 1990.**

```
SELECT COALESCE(Forests_country_name, Lands_country_name, Regions_country_name) AS
country_attributes,
 Forest_area_sqkm AS Forestry_area2016_sqkm
 FROM Forestation
 WHERE COALESCE(Lands_year, Forests_year) = 2016
```

```
AND
COALESCE (Forests_country_name, Lands_country_name, Regions_country_name) = 'World'
```

**Answer : The above query yielded the result of 39958245.9 square kilometers for the year 2016.**

**Below is the ENTIRE CTE Used for the Global Outlook.**

```
WITH CTE_Year1990 AS
( SELECT COALESCE (regions_country_name, forests_country_name,  lands_country_name) AS
country_attributes,
 forest_area_sqkm AS f_area1990_sqkm
 FROM forestation
 WHERE COALESCE(forests_year, lands_year) = 1990
 AND
 COALESCE (forests_country_name, lands_country_name, regions_country_name) = 'World' ),
CTE_Year2016 AS
(SELECT COALESCE (forests_country_name, lands_country_name, regions_country_name) AS
country_attributes,
 forest_area_sqkm AS f_area2016_sqkm
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016
 AND
 COALESCE (lands_country_name, regions_country_name, forests_country_name) = 'World' ),
CTE_World1 AS
 (SELECT CTE_Year1990.country_attributes,
 CTE_Year1990.f_area1990_sqkm,
 CTE_Year2016.f_area2016_sqkm,
 (CTE_Year2016.f_area2016_sqkm-CTE_Year1990.f_area1990_sqkm) AS differences_sqkm,
 ROUND(((CTE_Year2016.f_area2016_sqkm -
CTE_Year1990.f_area1990_sqkm)/CTE_Year1990.f_area1990_sqkm*100)::numeric,2)
 AS changes_percentage
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes),
CTE_World2 AS
 (SELECT COALESCE (FOREST_Master.forests_country_name, FOREST_Master.lands_country_name,
FOREST_Master.regions_country_name) AS country_nearest_proximity_diff,
 ROUND((FOREST_Master.total_area_sq_mi*2.59)::numeric,0) AS land_area_sqkm ,
 ABS(ABS(CTE_World1. differences_sqkm /2.59)-FOREST_Master.total_area_sq_mi) AS differences_in_value

 FROM forestation AS FOREST_Master, CTE_World1
 WHERE COALESCE(FOREST_Master.lands_year, FOREST_Master.forests_year) = 2016
 AND
 COALESCE(FOREST_Master.lands_country_name, FOREST_Master.regions_country_name,
FOREST_Master.forests_country_name) !=  'World'
```

```
ORDER BY 2 ASC
LIMIT 1)

SELECT CTE_World1.*, CTE_World2. country_nearest_proximity_diff, CTE_World2.land_area_sqkm
FROM CTE_World1, CTE_World2;
```

**3.REGIONAL OUTLOOK ANALYSIS**

**The regions, the countries, the year (1990 & 2016), the forest area square miles and total area square miles:**

```
SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name)
 AS country_attributes,
 COALESCE(forests_year,lands_year) AS yr,
 (forest_area_sqkm/2.59) AS forest_area_sqmi,
 total_area_sq_mi
 FROM forestation
 WHERE COALESCE(lands_year,forests_year) IN (1990,2016)
```

**This query yielded 436 rows. I figured this query is not enough. It's technically the same as doing a: SELECT * FROM forestation WHERE year IN (1990, 2016).**
**The entire CTE I used for the Regional Outlook questions:**

```
WITH CTE_Unit1 AS
(
 SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name)
 AS country_attributes,
 COALESCE(forests_year,lands_year) AS yr,
 (forest_area_sqkm/2.59) AS forest_area_sqmi,
 total_area_sq_mi
 FROM forestation
 WHERE COALESCE(lands_year,forests_year) IN (1990,2016)
),
CTE_Year1990 AS
(
 SELECT region,
 SUM(forest_area_sqmi) AS total_forests_sqmi1990,
 SUM(total_area_sq_mi) AS total_lands_sqmi1990
 FROM CTE_Unit1
 WHERE yr = 1990
 GROUP BY region
),
CTE_Year2016 AS
(
 SELECT region,
```

```
 SUM(forest_area_sqmi) AS total_forests_sqmi2016,
 SUM(total_area_sq_mi) AS total_lands_sqmi2016
 FROM CTE_Unit1
 WHERE yr = 2016
 GROUP BY region
)
SELECT CTE_Year1990.region,
 ROUND((total_forests_sqmi1990/total_lands_sqmi1990*100)::numeric,2)
 AS pct_forest_1990,
 ROUND((total_forests_sqmi2016/total_lands_sqmi2016*100)::numeric,2)
 AS pct_forest_2016
FROM CTE_Year1990
INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.region = CTE_Year2016.region;
```

**4.Country-Level Details**

**The entire WITH() Clause that I used in answering the first question :**

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS country_attributes
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
(
 SELECT CTE_Year1990.region,
 CTE_Year1990.country_attributes,
```

```
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS
changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeric,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC
)
SELECT *
FROM CTE_Global
WHERE changes_sqkm IS NOT NULL
ORDER BY changes_sqkm ASC
LIMIT 5;
```

**The entire CTE Below is what I used in answering the 2nd question, 2nd paragraph of the actual paper.**

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
(
 SELECT CTE_Year1990.region,
 CTE_Year1990.country_attributes,
```

```
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeri
c,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC
)
SELECT *
FROM CTE_Global
WHERE pct_change IS NOT NULL
ORDER BY pct_change DESC
LIMIT 1;
```

**Below is for the 3rd question in the homework: (Country Level Details, Table 3.1)**

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS country_attributes
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
(
 SELECT CTE_Year1990.region,
```

```
 CTE_Year1990.country_attributes,
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS
changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeric,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC
)
SELECT *
FROM CTE_Global
WHERE changes_sqkm IS NOT NULL
ORDER BY changes_sqkm ASC
LIMIT 5;
```

Below is the code I used for Main Paper's Table 3.2

```
WITH CTE_Year1990 AS
(
 SELECT region,
forest_area_sqkm AS forest_area1990_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS country_attributes
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 1990 AND region != 'World'
),
CTE_Year2016 AS
(
 SELECT region,
forest_area_sqkm AS forest_area2016_sqkm,
 COALESCE (lands_country_name, regions_country_name,forests_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest_area_2016
 FROM forestation
 WHERE COALESCE(lands_year, forests_year) = 2016 AND region != 'World'
),

CTE_Global AS
(
 SELECT CTE_Year1990.region,
 CTE_Year1990.country_attributes,
```

```
 CTE_Year1990.forest_area1990_sqkm,
 CTE_Year2016.forest_area2016_sqkm,
 ROUND((CTE_Year2016.forest_area2016_sqkm-CTE_Year1990.forest_area1990_sqkm)::numeric,2) AS
changes_sqkm,
 ROUND(((CTE_Year2016.forest_area2016_sqkm-
CTE_Year1990.forest_area1990_sqkm)/CTE_Year1990.forest_area1990_sqkm*100)::numeric,2)
 AS pct_change,
 ROUND(CTE_Year2016.pct_forest_area_2016::numeric,2) AS pct_forest_area_2016
 FROM CTE_Year1990
 INNER JOIN
 CTE_Year2016
 ON CTE_Year1990.country_attributes = CTE_Year2016.country_attributes
 AND
 CTE_Year1990.region = CTE_Year2016.region
 ORDER BY 1 ASC )
SELECT *
FROM CTE_Global
WHERE pct_change IS NOT NULL
ORDER BY pct_change ASC
LIMIT 5;
```

Below is the code I used for the (Country Level Details- Project's Table 3.3 )- Regarding Quartiles

```
WITH CTE_Quartile1 AS
(
 SELECT region,
 COALESCE (lands_country_name, regions_country_name, forests_country_name) AS
country_attributes,
 ROUND(percent_forest_area::NUMERIC,2) AS forest_area_pct
 FROM forestation
 WHERE COALESCE(forests_year,lands_year) = 2016 AND region != 'World'
 AND percent_forest_area IS NOT NULL
),
CTE_Quartile2 AS
(
 SELECT country_attributes, forest_area_pct, region,

 CASE WHEN forest_area_pct > 75.00 THEN 'Quartile_4'
 WHEN forest_area_pct > 50.00 AND forest_area_pct <= 75.00 THEN 'Quartile_3'
 WHEN forest_area_pct > 25.00 AND forest_area_pct <= 50.00 THEN 'Quartile_2'
 ELSE 'Quartile_1' END AS quartile_ranges

 FROM CTE_Quartile1
)
SELECT quartile_ranges, COUNT(quartile_ranges)
```

```
FROM CTE_QuarTile2
GROUP BY quartile_ranges
ORDER BY quartile_ranges ASC;
```

**The last Query below was used to answer the number of countries with higher % forestations than United States.**

```
WITH USA_QUERY AS
(
 SELECT COALESCE (lands_country_name, forests_country_name,regions_country_name) AS
country_attributes,
 percent_forest_area AS pct_forest2016
 FROM forestation
 WHERE COALESCE(forests_year,lands_year) = 2016 AND region != 'World'
 AND percent_forest_area IS NOT NULL
)
SELECT COUNT(*) AS nations_greater_than_USA
FROM USA_QUERY
WHERE pct_forest2016 > (
 SELECT pct_forest2016
 FROM USA_QUERY
 WHERE country_attributes = 'United States'
 );
```

***** ------ END of REPORT ------- *****